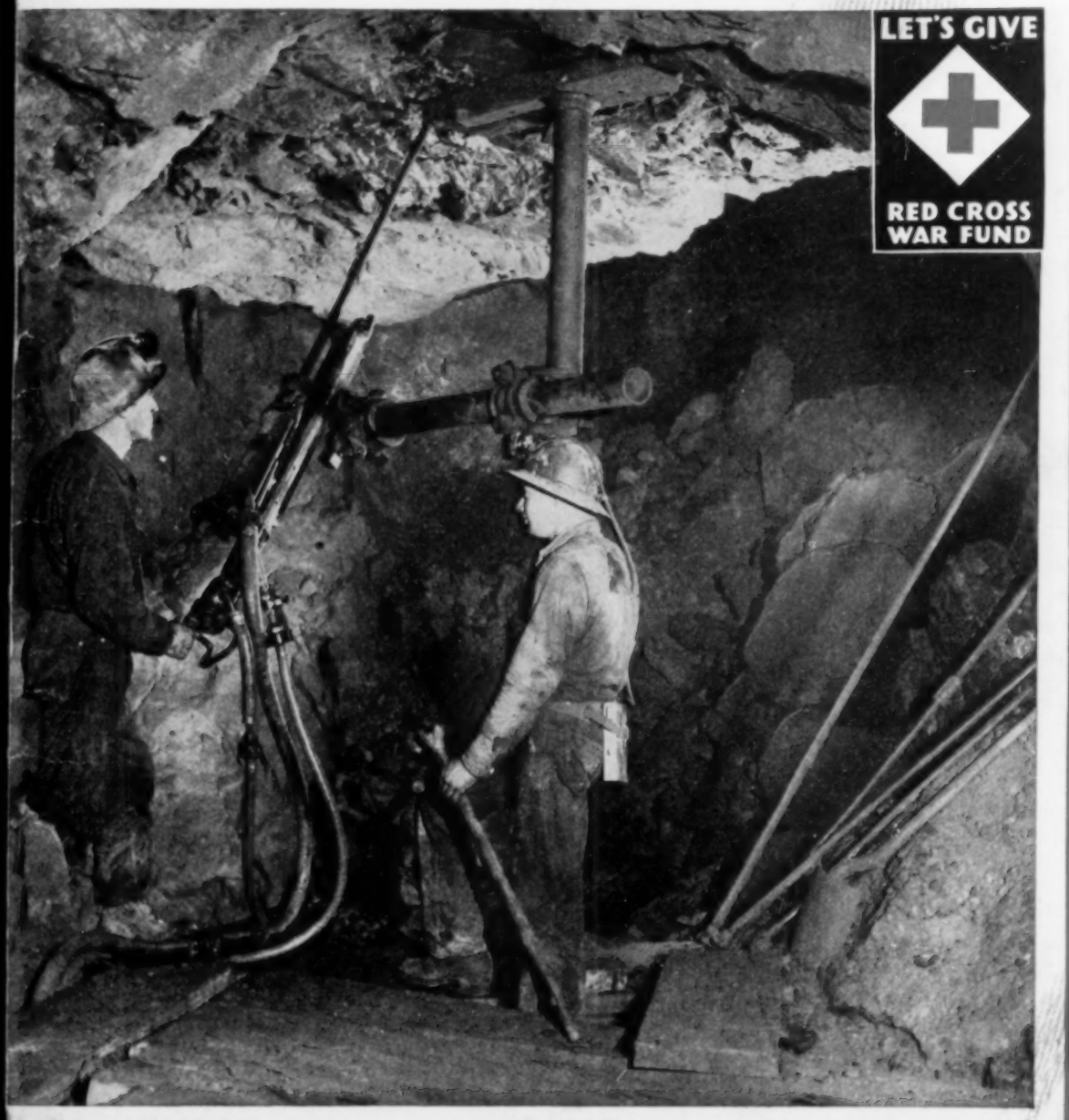
Compressed Air Magazine

MARCH 1944

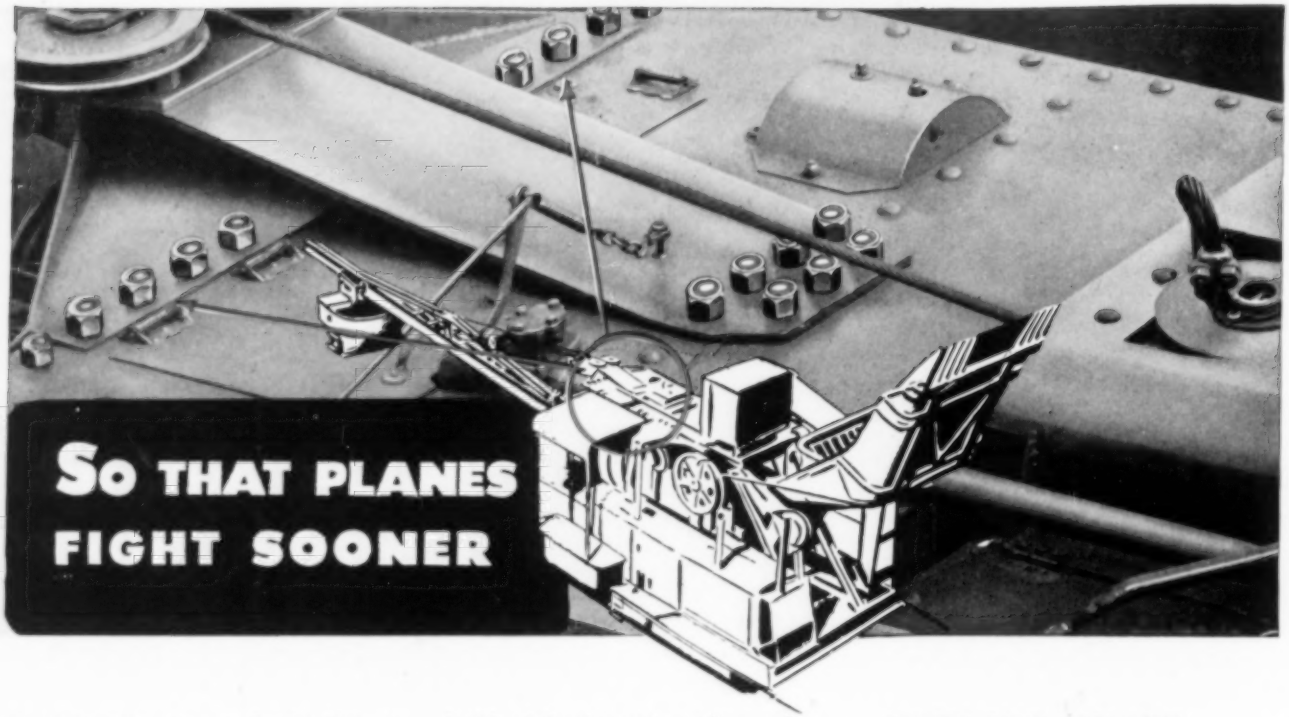


DRILLING DEEP BLAST HOLES

Lengths of drill steel are coupled together to gain desired depth of hole.

VOLUME 49 • NUMBER 3

NEW YORK • LONDON



SO THAT PLANES FIGHT SOONER

RANSOME pavers built American highways. Now they are rushing airports along our battle fronts.

Every hour of construction time they can save gives that much advantage to our fighting airmen.

Paving is a shattering job. And it used to be accepted that frequent take-ups and tightening were part of paver maintenance.

But no more! Not since Ransome began using Elastic Stop Nuts—the nuts that stay put.

Now the paver keeps on the go longer, and our planes fight sooner.

The reason Elastic Stop Nuts hold tight in spite of wracking vibration lies in the elastic collar in their tops. This snuggles close around the bolt threads, grips them and prevents the nut from turning and loosening.

Countless fastening problems lie ahead in the coming days of peace. Many of them will be solved successfully with Elastic Stop Nuts. Products will be safer, and longer-lasting. Production equipment will stay at work with less maintenance.

If you are faced with a fastening problem, feel free to call upon us. Our engineers will gladly help you solve it and suggest the proper Elastic Stop Nut.

ELASTIC STOP NUTS HELP BIG, BUSY RANSOME PAVERS DO MANY VITAL WAR JOBS

"Concrete road pavers are subjected to tough, grueling work, especially on twenty-four-hours-a-day service, for which many Ransome Pavers have been called upon in the construction of airport runways since the war started. All told, there are about 1,200 Elastic Stop Nuts used on every Ransome Paver we build. By substituting Elastic Stop Nuts for the ordinary kind, we are helping the Ransome Paver owner minimize his maintenance job because the nuts are self-locking and vibrationproof. No time out for tightening—no extra hours of labor to take up slack. Elastic Stop Nuts also simplify our shop assembly job. They are a further contribution to the improvement of our paver, which is our constant goal."

J. J. Faber Chief Engineer

RANSOME MACHINERY CO., DUNELLEN, N. J.
Subsidiary of Worthington Pump and Machinery Co.

ESNA

TRADE MARK OF
ELASTIC STOP NUT CORPORATION
OF AMERICA

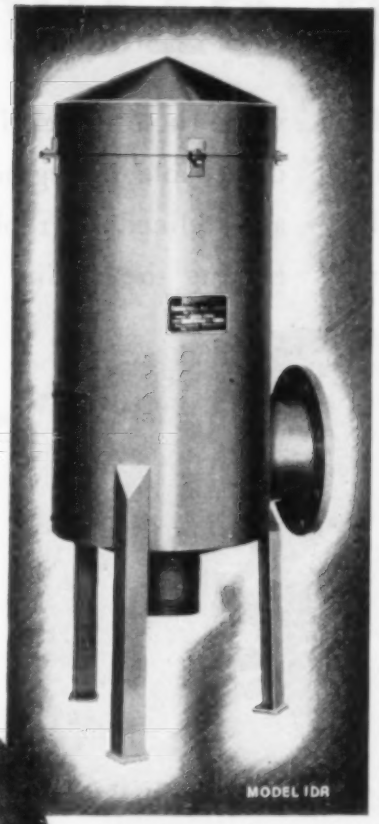
ELASTIC STOP NUTS

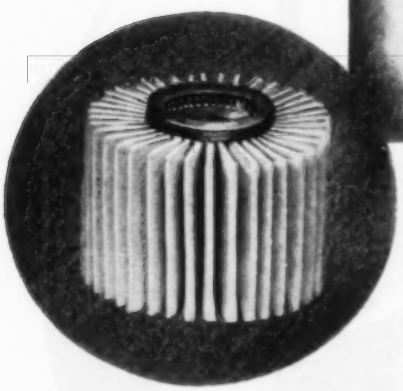
Lock fast to make things last

UNION, NEW JERSEY AND
LINCOLN, NEBRASKA

LOCKED ON THE BOLT BY THE ACTION OF THE GRIPPING RED COLLAR.
THE COLLAR IS ELASTIC, THE NUT CAN BE USED TIME AND TIME AGAIN.
MADE IN ALL SIZES AND TYPES—WITH THREADS TO FIT ANY STANDARD TYPES OF BOLTS.

new STAYNEW Intake Air Filter





EXCLUSIVE RADIAL FIN CONSTRUCTION PROVIDES:

- *More Filtering Area
- *Greater Efficiency
- *Less Resistance
- *Less Frequent Servicing

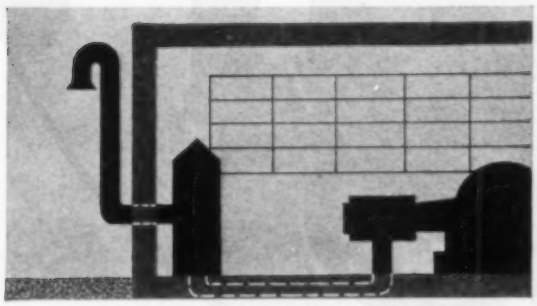
ALL THE CONVENIENCE OF GROUND LEVEL INSTALLATION

ALL THE EFFICIENCY OF HIGH LEVEL AIR INTAKE

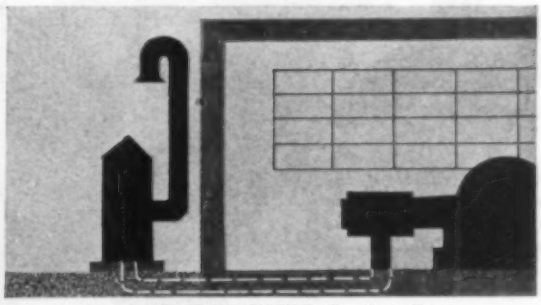
NOW you can equip compressors and internal combustion engines with a Staynew filter providing all the recognized advantages of the famous Protectomotor line . . . *plus* an exclusive combination of two new features .

The new filter, Staynew Model IDR, or IDRS (Silencer), is so constructed that *installation and servicing can be effected at ground level* (right in the engine room itself if preferred), and the *actual air intake located at the most suitable point.*

Models available with solid base for installation when compressor or engine intake is below floor level.



Model IDR INSIDE Engine Room



Model IDR OUTSIDE Engine Room

Engineering Data on request STAYNEW FILTERS Representatives in Principal Cities

DOLLINGER CORPORATION

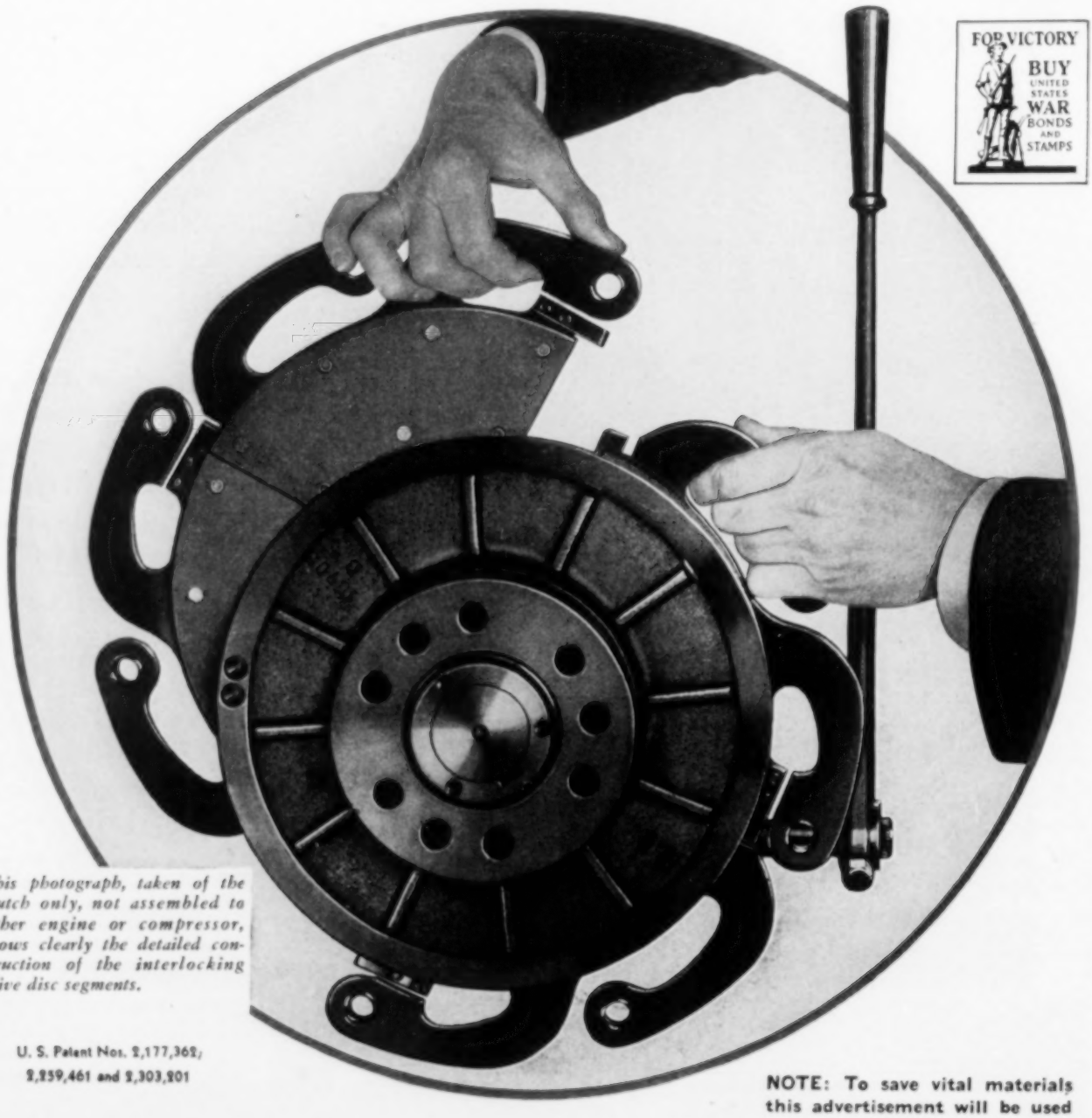
(Formerly Staynew Filter Corporation)

7 Centre Pk.

Rochester 4, N. Y.

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

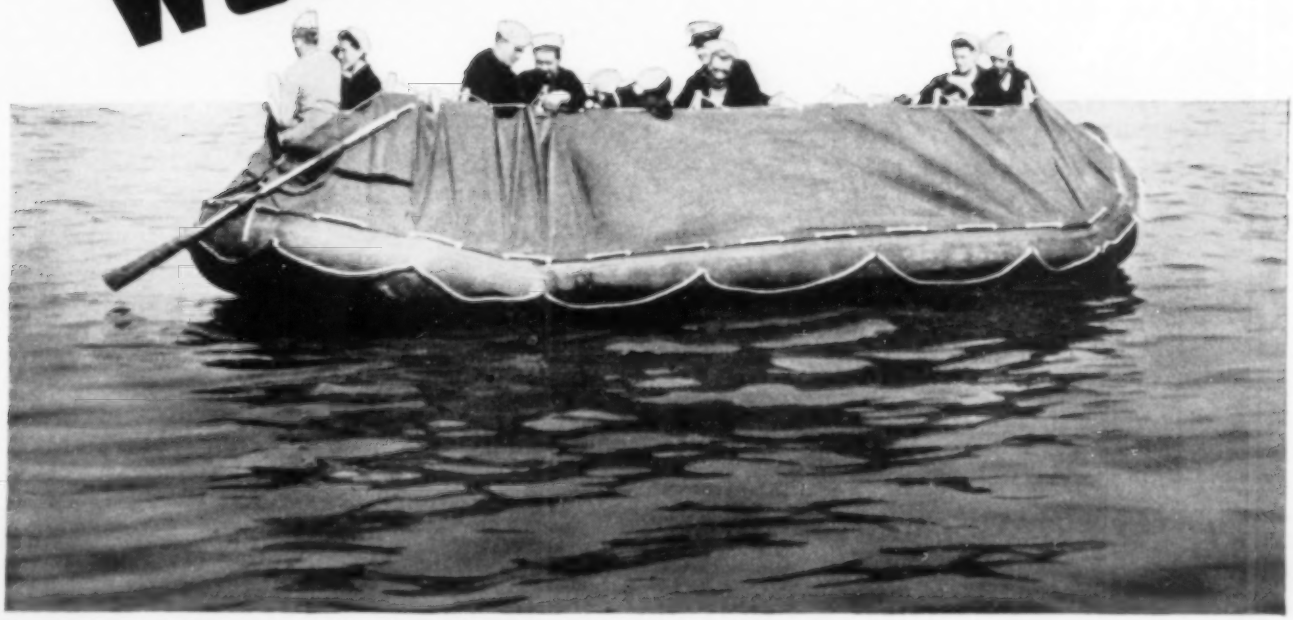
U. S. Patent Nos. 2,177,362, 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

WORLD'S LARGEST...



IT'S a 25-foot "ocean liner" in rubber, this newest, largest life raft, with protective weather curtains, and 30 days' rations for 25 persons. Stowed aboard ship, it packs into a space 5 x 7 x 1½ ft.

Inflating this raft from a small cylinder in seconds, is another vital contribution of compressors to the Nation's war effort.

To get maximum performance from compressors in whatever service, more and more operators are lubricating with Texaco.

The use of *Texaco Alcaid, Algol* or *Ursa Oils* assures wide-opening, tight-closing valves, free piston rings, open ports, clear lines. This means maximum service life between overhauls, fewer repairs and replacements.

So effective have Texaco lubricants proved that they are definitely preferred in many fields, a few of which are listed on the right.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States.

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

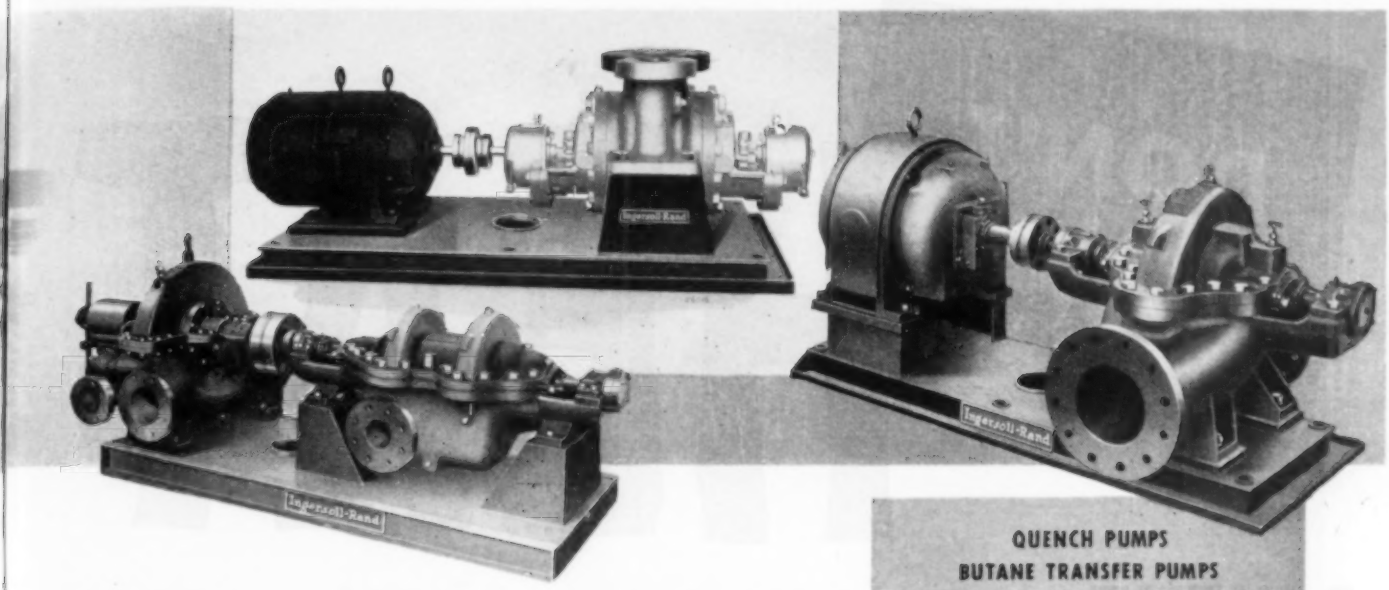
TEXACO

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT – CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

SUN'S NEWEST AVIATION FUEL PLANT BOOSTS 100-OCTANE OUTPUT
Adds to Sunoco's position as one of the world's largest producers of aviation fue
Now in full operation, Sunoco's huge new aviation gasoline plant is the large
its type in existence. In this self-contained plant, all petroleum components of av
gasoline are produced and blended into the finest 100-octane fighting fuel.
The new plant, added to the giant facilities already in operation, makes our Marcus
Hook refinery one of the largest producers of 100-octane aviation fuel in the world.
Sun First to Make Catalytic Cracking Commercially Practical
Sunoco's leadership really began long before Pearl Harbor, when the company first
made commercially practical a now-famous process of catalytic cracking. No greater
contribution has been made to the war effort. For, without the principle of catalytic
cracking, Allied aviation fuel requirements could not have been met.
A Triumph of Private Initiative
Sunoco's entire aviation fuel program has been accomplished without government
aid or subsidy. Facilities costing more than 36 million dollars are now devoted to
war production in the company's Marcus Hook refinery alone. It is only through
such free play of private initiative that all American progress has been achieved.
SUNOCO
EVERYTHING SUNOCO DOES HAS VICTORY AS ITS PURPOSE
INGERSOLL-
GAS ENGINE DRIVEN COMPRESSORS
—battery of eight 300 HP Type XVG gas engine-driven gas compressors serving the gas recovery and stabilization unit in Plant #15 at Marcus Hook

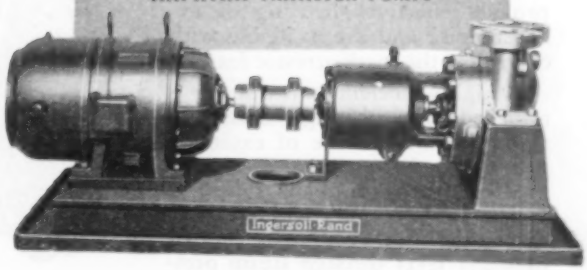


RAND COMPRESSORS and PUMPS *Serve Sun's New Aviation Fuel Plant*

INGERSOLL-RAND refinery compressors and pumps are holding key positions in another new and vital fuel plant... one that boosts Sun's Marcus Hook Refinery output to enough 100 octane aviation gasoline to propel 2000 four-engine bombers from England to Berlin and back each week.

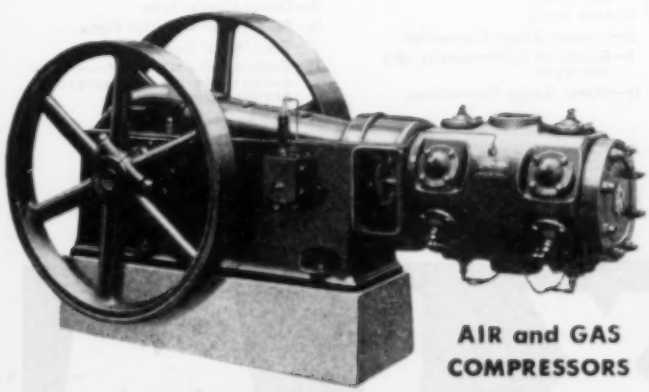
These pumps and compressors are heavy-duty machines that operate 24 hours-a-day, week after week. That's worth remembering when you need compressors, pumps and jets for refinery or process work.

QUENCH PUMPS
BUTANE TRANSFER PUMPS
FUEL OIL PRODUCTS PUMPS
HEAVY GAS OIL PRODUCTS PUMPS
RIVER WATER PUMPS
CONDENSATE PUMPS
BACK-WASH AND COOLING WATER PUMPS
MOLTEN SALT PUMPS
DEPROPANIZER REBOILER PUMPS
CONDENSATE PUMPS
NAPHTHA TRANSFER PUMPS



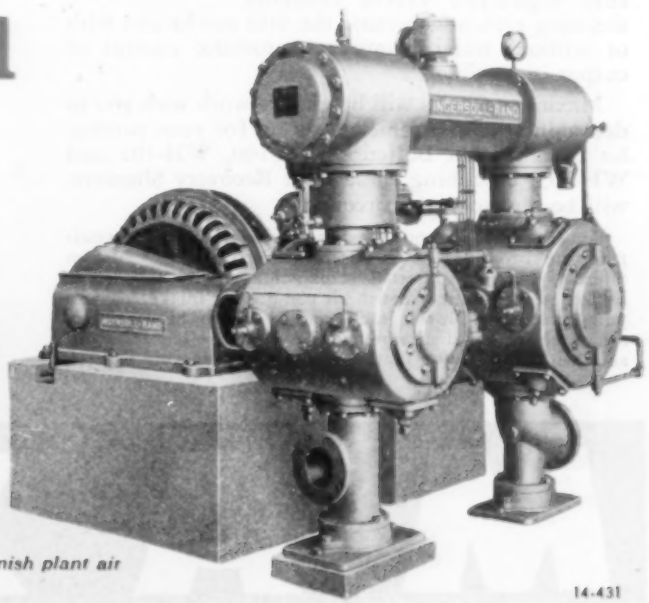
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.



AIR and GAS COMPRESSORS

– belt-driven and electric-driven compressors used to furnish plant air and also on butane recovery



14-431

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

DON'T WASTE HEAT

SAVE IT with MAXIM HEAT RECOVERY SILENCERS

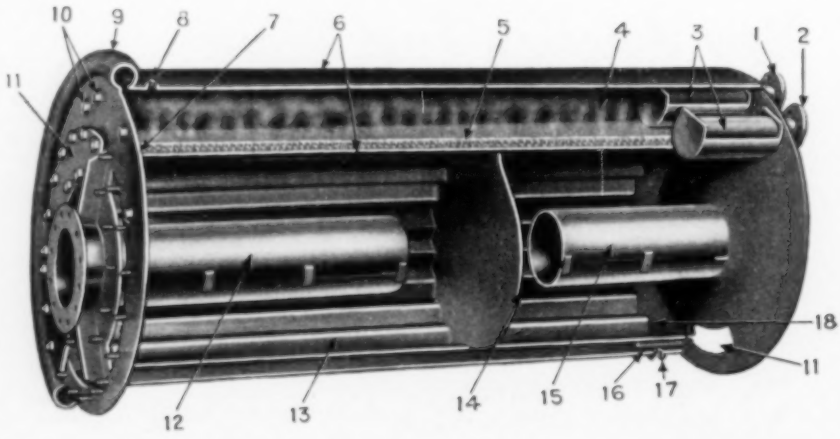
Maxim Heat Recovery Silencers convert waste exhaust heat into steam or hot water for industrial processing operations or for heating.

These Heat Recovery Silencers provide effective silencing of exhaust noise and are available with or without the spark arrestor feature.

A highly efficient heat transfer is achieved through high mass gas velocities and the use of extended heating surfaces. Because of this type of construction (no tubes) it is possible to run dry without damage to the unit. Automatic control of water level through steam pressure regulated valves controls steaming rate, and because the unit can be run with or without water, complete automatic control of output is possible.

Maxim engineers will be glad to work with you to determine the most efficient set-up for your particular case. Maxim Bulletins WH-100, WH-102 and WH-103, describing these Heat Recovery Silencers, will be sent to you on request.

For silencing, without the heat recovery feature, investigate the broad range of usefulness covered by Maxim Silencers . . . for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.

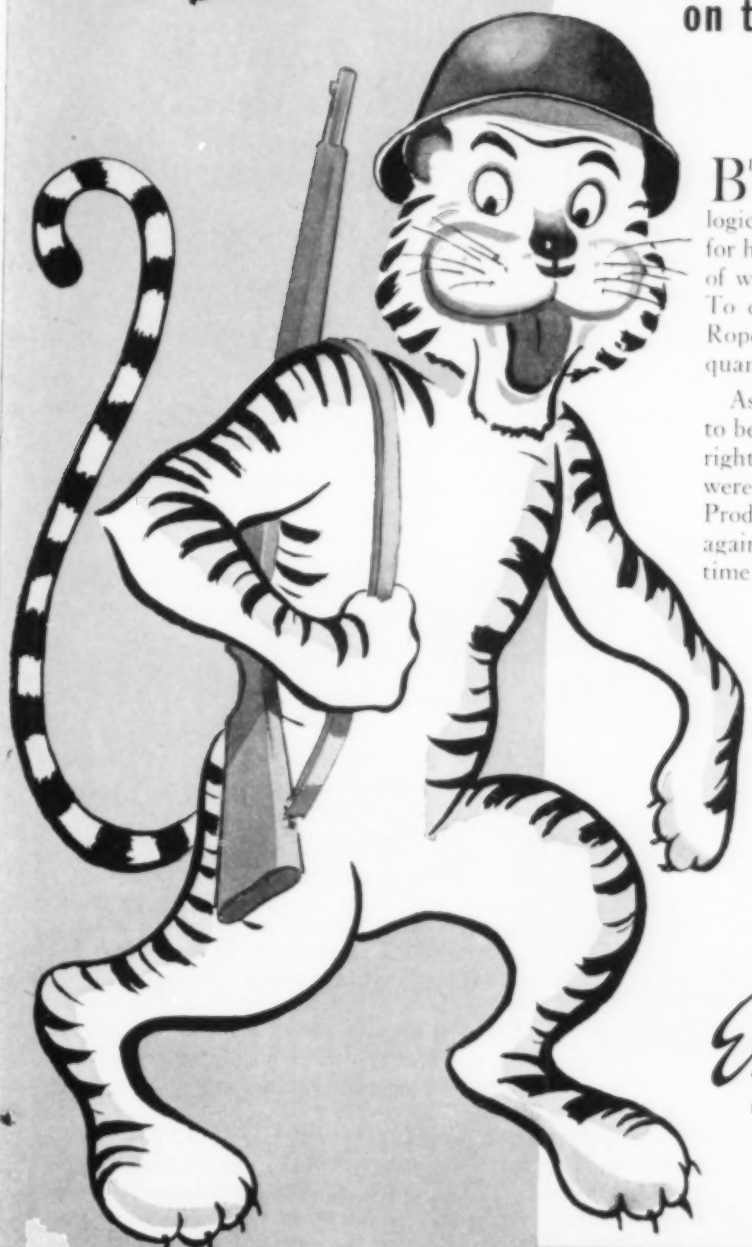


1—Steam Outlet
2—Safety Valve Connection
3—Dry Pipes
4—Steam Space
5—Water Line
6—Shells—Cylindrical to withstand steam pressure and pulsating gas flow
7—Inlet Head
8—Pressure Gauge Connection
9—Expansion Joint—permits dry operation
10—Water Gauge Connections
11—Cleanouts—provide easy access for cleaning heating surface
12—Inlet Bleeder Tube
13—Extended Heating Surface—forming conduits for leading exhaust gases from one attenuating chamber to the other
14—Insulated Intermediate Head
15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

THE MAXIM SILENCER CO.
85 Homestead Ave., Hartford, Conn.

ARMY (E) NAVY

MAXIM



Tiger Brand has been scarce on the home front . . . for military reasons only

BECAUSE we are the world's largest manufacturers of wire rope, it was logical for Uncle Sam to turn to us early for help in supplying the huge tonnages of wire rope needed for the war effort. To date, American Tiger Brand Wire Rope has been used in breath-taking quantities on every front.

As new and unusual service tasks had to be faced, our engineers produced the right wire rope to meet them. Our plants were kept running around the clock. Production facilities were expanded again and again to keep pace with wartime needs.

Now a growing amount of Tiger Brand is becoming available for use here at home. This wire rope incorporates all the improvements that war-stimulated advancement in rope-making technique provides. So, when you need rope—and want the best—get in touch with your Tiger Brand distributor.

Excellay Preformed

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

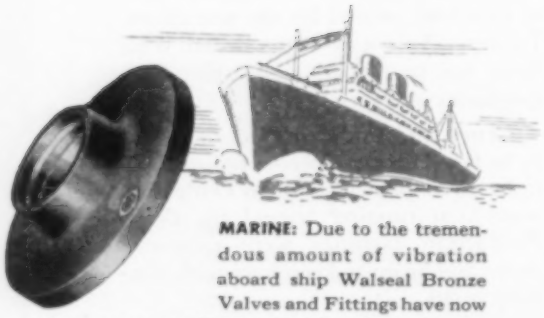
UNITED STATES STEEL

WALSEAL*

VALVES, FITTINGS AND FLANGES

... the best for every type of service

WHEREVER BRASS OR COPPER PIPE IS USED



MARINE: Due to the tremendous amount of vibration aboard ship Walseal Bronze Valves and Fittings have now become practically standard for all non-ferrous piping. While under normal conditions there is considerable vibration on shipboard, during war the added shock caused by explosions doesn't affect the Silbraz joints made with Walseal Valves and Fittings.

BUILDING: On non-ferrous piping in buildings, Walworth Walseal Bronze Valves and Fittings are being increasingly used. By the use of Silbraz joints made with Walseal Valves or Fittings, costly repairs and shut-downs of pipe lines are eliminated. No properly made Silbraz joint has ever failed.

Silbraz* joints made with Walseal threadless valves, fittings, and flanges are permanently tight and leakproof — truly make one-piece copper or brass pipe lines. The ring of silver brazing alloy incorporated in each port opening brazes the pipe or tube to the Walseal product when heated by an oxyacetylene flame. The resulting Silbraz joint is stronger than the pipe itself.

RAILROADS: With the increased use of Diesel engines the problem of absolutely tight joints, when subject to excessive vibration and wear, on air lines, lubricating oil lines, etc. tight joints are an absolute must. Walseal Valves and Fittings are now rapidly becoming standard on this type of equipment.

Walseal valves, fittings, and flanges are patented products of the Walworth Company, manufacturers of valves and fittings since 1842. The complete line of Walseal products includes types and sizes for every installation where copper or brass piping is used.

For detailed information on the entire line of Walworth products, write on your company letterhead for a free copy of Walworth Catalog 42. It includes 78 pages of engineering information to help you choose the Walworth product that exactly fits your particular service need.

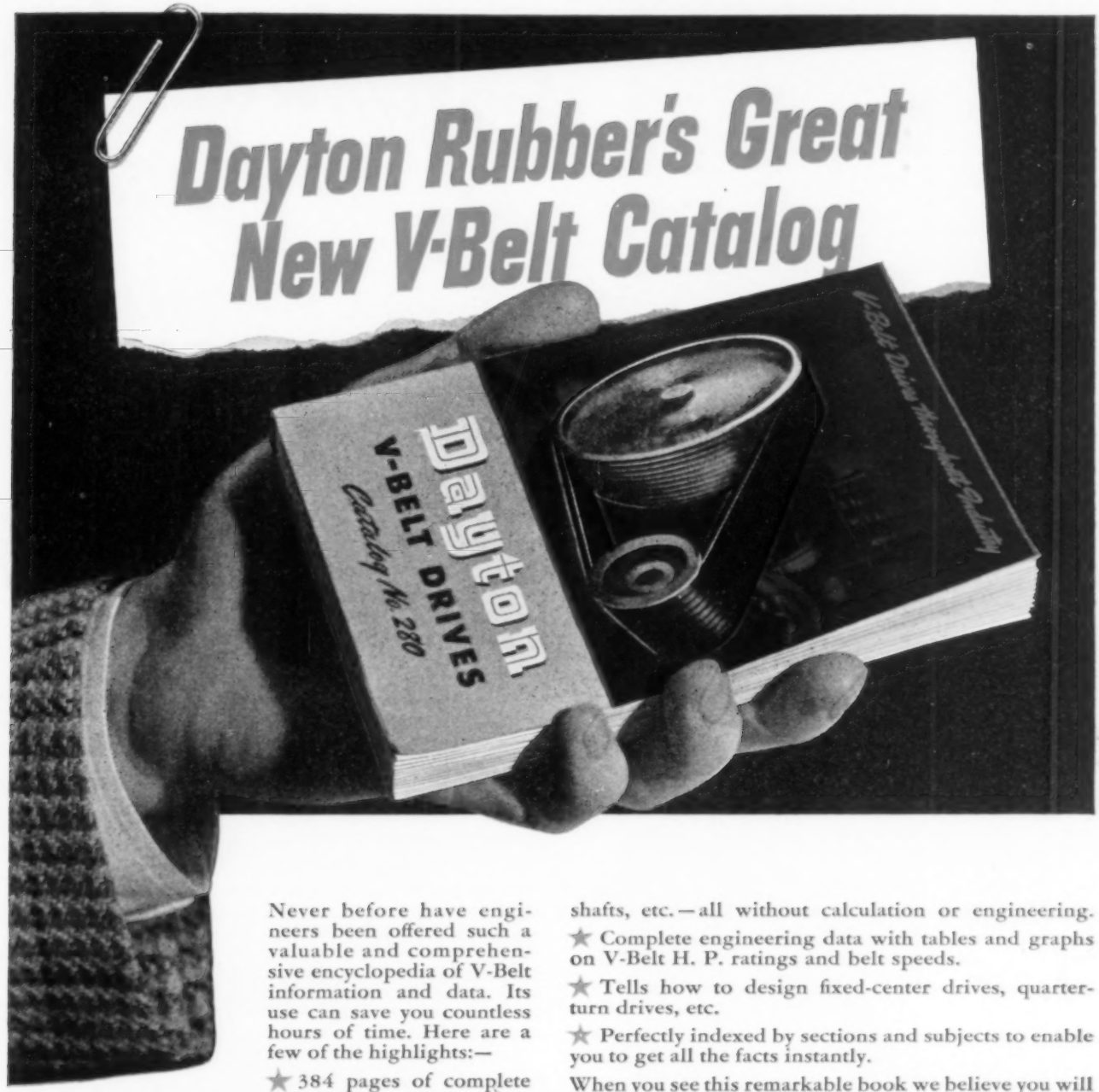
*Registered trade marks

BOSTON WORKS
KEWANEE WORKS

WALWORTH
valves AND fittings
60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Dayton Rubber's Great New V-Belt Catalog



Never before have engineers been offered such a valuable and comprehensive encyclopedia of V-Belt information and data. Its use can save you countless hours of time. Here are a few of the highlights:—

★ 384 pages of complete drive information and data in one handy pocket-size volume.

★ Lists millions of drive combinations for quick, easy selection.

★ Comprehensive V-to-V and V-Flat Drive data for planning rapid conversion of production.

★ Lists for the first time in any V-Belt catalog, speed-up V-Belt Drives for standard motor speeds; speed-up and speed-reduction drives for engines, jackshafts, etc.—all without calculation or engineering.

★ Complete engineering data with tables and graphs on V-Belt H. P. ratings and belt speeds.

★ Tells how to design fixed-center drives, quarter-turn drives, etc.

★ Perfectly indexed by sections and subjects to enable you to get all the facts instantly.

When you see this remarkable book we believe you will agree that its publication is further evidence of Dayton's leadership in the V-Belt field. If you have not received your copy, write for it today.

LET'S ALL BACK THE ATTACK WITH WAR BONDS

THE DAYTON RUBBER MANUFACTURING CO.
DAYTON 1, OHIO

One of the operators of the first Government Dual-Unit Type Synthetic Rubber Production Plants

V-Belts by Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

Standard Motor Control

FOR POSTWAR RECONVERSION

Westinghouse All-Purpose A-C Controls

Postwar reconversion will bring important control problems—you'll need all-purpose controls—and you'll need them quick.

Westinghouse is ready NOW to help you solve these problems—with a complete family of A-C Controls, a few of which are pictured here. They offer the maximum in flexibility of application and ease of installation.

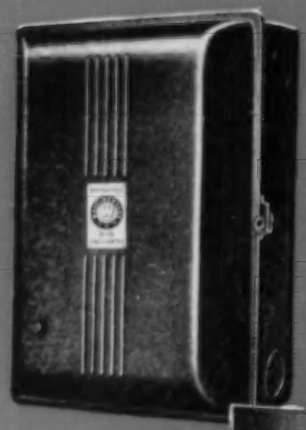
Start now to anticipate your postwar control needs. For your assistance, Westinghouse has compiled a complete new volume of Control Buying Data (Catalog 7000). Get your copy today from the nearest Westinghouse district office (distribution will be made from district offices only—no mailings from Westinghouse headquarters). Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penna.

J-21307

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Motor Control



Across-the-line A-C Magnetic Starter for Squirrel-cage Motors.

Reversing and Non-reversing Magnetic Starter.

Autotransformer Type Magnetic Reduced Voltage Starter.

Starting and speed regulating Rheostat.

Manual Motor-starting Snap Switch.

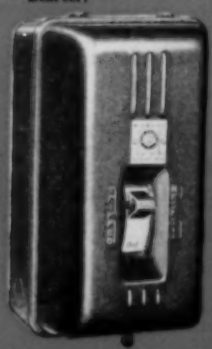
Reversing Drum Switches for Across-the-line Starting.

Type H Sentinel Breaker for Fractional Hp Motor Starting.

Manual Multi-speed Drum Controllers.

"De-ion" Motor Watchman Reversing and Two-speed Manual Starters.

Manual Multi-speed Drum Controllers.



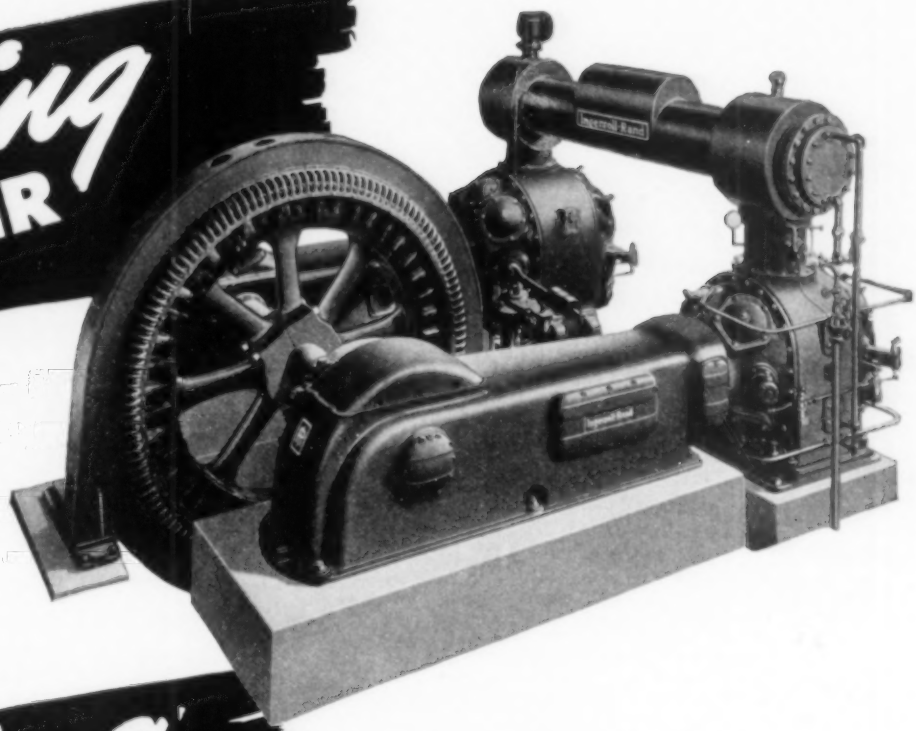
Across-the-line "De-ion" Manual Motor Starter.

Reversing Drum Controller for use with Primary Resistance.

Making THE AIR

OR

Using THE AIR



—PROTECT YOUR EQUIPMENT AT BOTH ENDS OF YOUR LINE

Air tool or air compressor—there's a Shell Lubricant "custom-refined" to fit both types of equipment.

Shell Compressa Oil, for air compressors, and Shell Clava Oil, for air tools, both contain the specific characteristics to match the job for which it is to be used. For only when the lubricant *matches* the job are you sure of a thoroughly reliable performance.

Send today for details on Shell's "Custom-Refined" Lubricants for compressed air use.

SHELL *COMPRESSED AIR* LUBRICANTS

COMPRESSA OIL
FOR AIR COMPRESSORS

CLAVA OIL
FOR AIR TOOLS

"It's the Eimco Rocker t

Say Mine Owners Everywhere

Yes, it's the Eimco *patented* Rocker Arm—massive muscles that give top-notch performance twenty-four hours a day; simplicity of design that gives the Eimco Loader its unusual versatility, its maximum power, and its quick gravity return. Rolling on a solid alloy steel deck, its shape supplies the extra forward thrust that makes digging and lifting easy, takes a minimum of headroom and provides proper discharge to suit the mine car. But the Eimco Loader has many other *patented* features that make it a winner—adjustable thrust stops, automatic centering, digging width stops, trigger-fast controls, as well as superior overall construction.

From the mining companies who operate more than a hundred Eimco Loaders to those who only operate one, the choice has been made on merit.

Model 12B equipped with two heavy duty five cylinder pneumatic motors, capacity 1 to 2 tons per minute and weighs 4200 pounds; track gauges 15" to 36".

Model 21 powered by two heavy duty five cylinder pneumatic or electric motors, capacity 2 to 3 tons per minute and weighs 7200 pounds; track gauges 18" to 48".

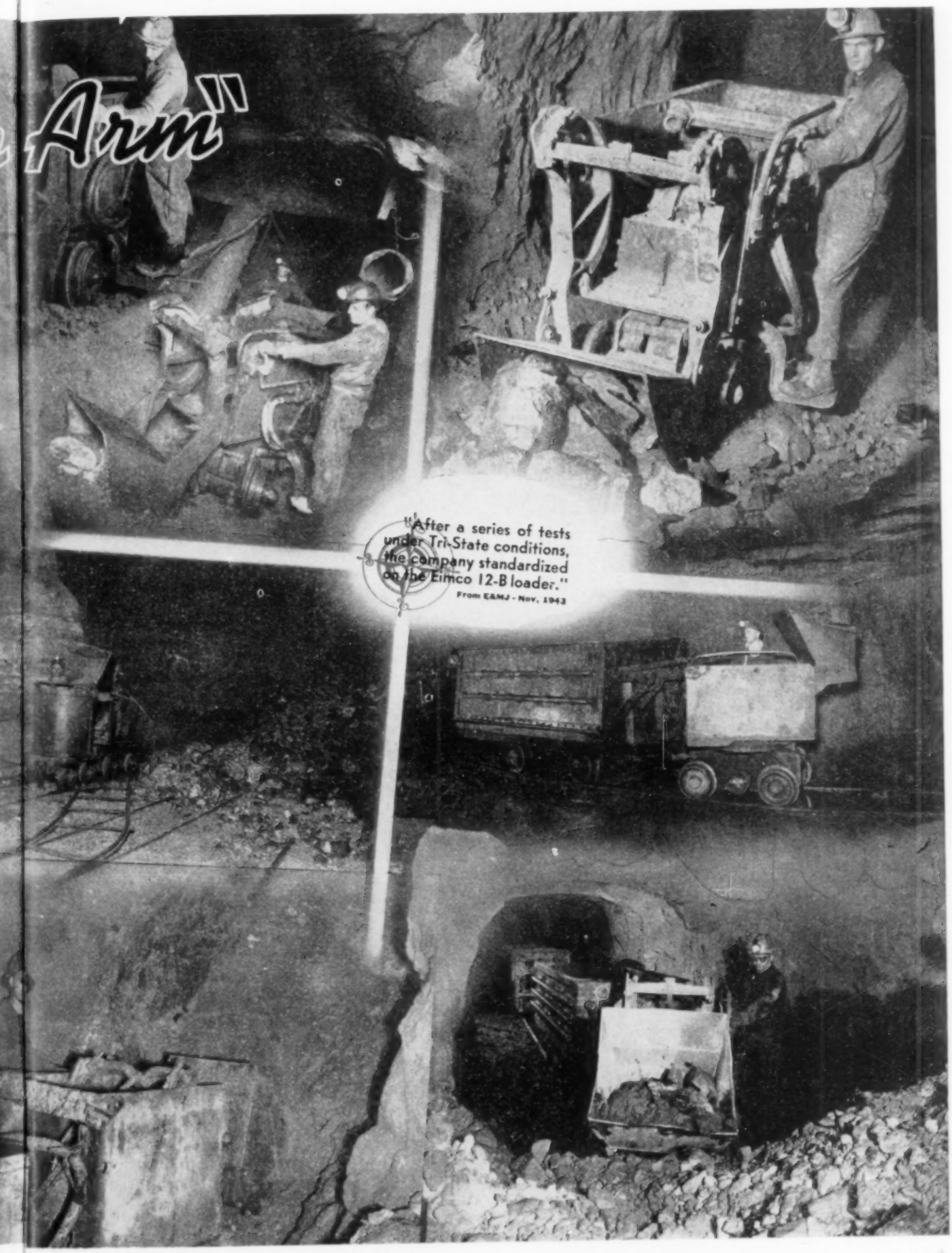
Model 40 equipped with a ½ cubic yard bucket, powered by air or electric motors, capacity 3 to 4 tons per minute and weighs 14,000 pounds; track gauges 30" to standard railroad gauge.

EIMCO

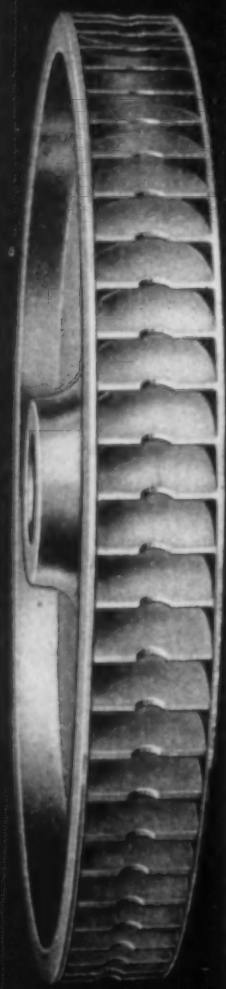
THE EIMCO CORPORATION, SALT LAKE CITY 8 UTAH

NEW YORK 120 BROADWAY
CHICAGO, 111 W. WASHINGTON ST.
SACRAMENTO, 1217 7TH ST.
EL PASO, MILLS BUILDING

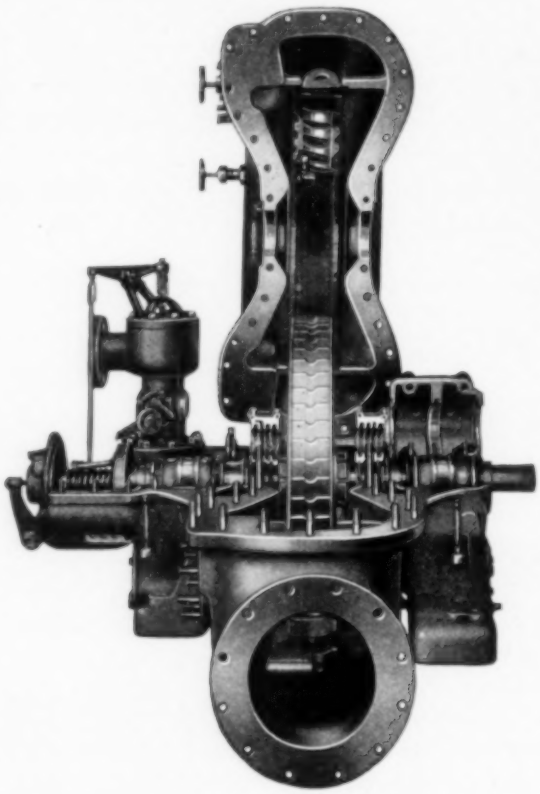
EIMCO PATENTS—Give exclusive rights to the use of any rocker-arm profile other than a segment of a true circle and to the use of any rocker-arm which rolls on a supporting track or bed. No other known method for controlling the action of a mucking machine permits such simple sturdy construction or gives such high operating efficiency.


Arm"
"After a series of tests under Tri-State conditions, the company standardized on the Eimco 12-B loader."
From E&MJ - Nov. 1943

TERRY



SOLID WHEEL DOUBLE-RIM TURBINES are PROTECTED



In Terry Wheel Turbines the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

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Above:
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T-1140

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W-954

NORTON ABRASIVES

Your RED CROSS is at his side

•

ON THE COVER

OUR cover picture illustrates the use of rock-drilling equipment in sublevel slot mining at a large western copper producer. The miners have set up their standard DA-35 power-feed drifter in the sublevel adjacent to the slot and are drilling steeply inclined up holes a maximum distance of 48 feet. Hollow, round 1¼-inch drill steel is used and is lengthened by joining sections with I-R Type 2 couplings. The two men average 80 feet of hole per shift, including setting-up time. Powder is placed in the holes with jointed loading sticks and is fired with Primacord. The holes break into the open slot when blasted. A breakage of approximately 3 tons per foot of hole, or 120 tons per driller shift, is obtained by this method, which is of prime importance to the mining company.

•

IN THIS ISSUE

OUR leading article tells the story of the new steel plant of Kaiser Company, Inc., the first establishment of its kind on the Pacific Coast.

•

THE second article describes the seadrome scheme of building bases in the Atlantic Ocean for air travel to Europe.

•

THE story of the Santa Fe Trail, an account of a mercury-mining venture in Texas, some facts concerning the important war metal tantalum, and a description of the use of compressed air in moving cement at Fontana Dam round out the principal articles.

Compressed Air Magazine

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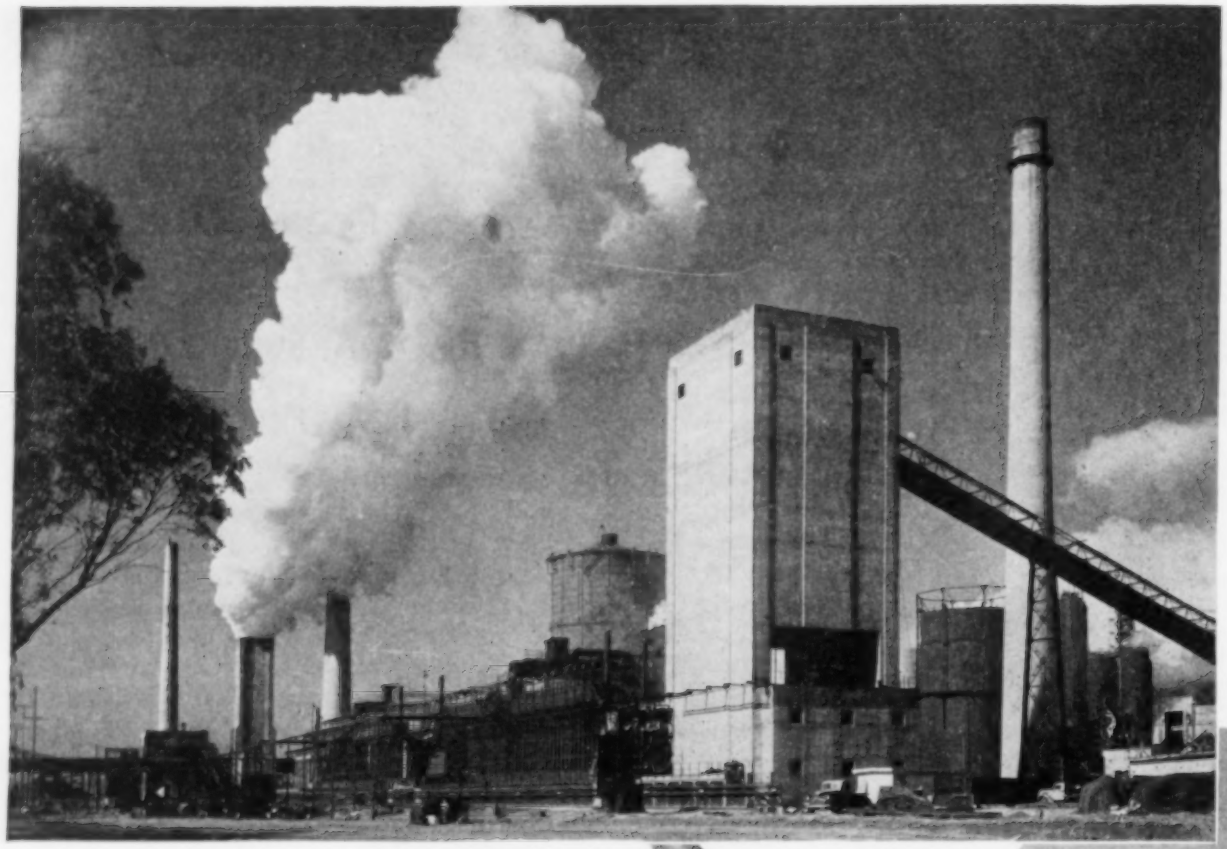
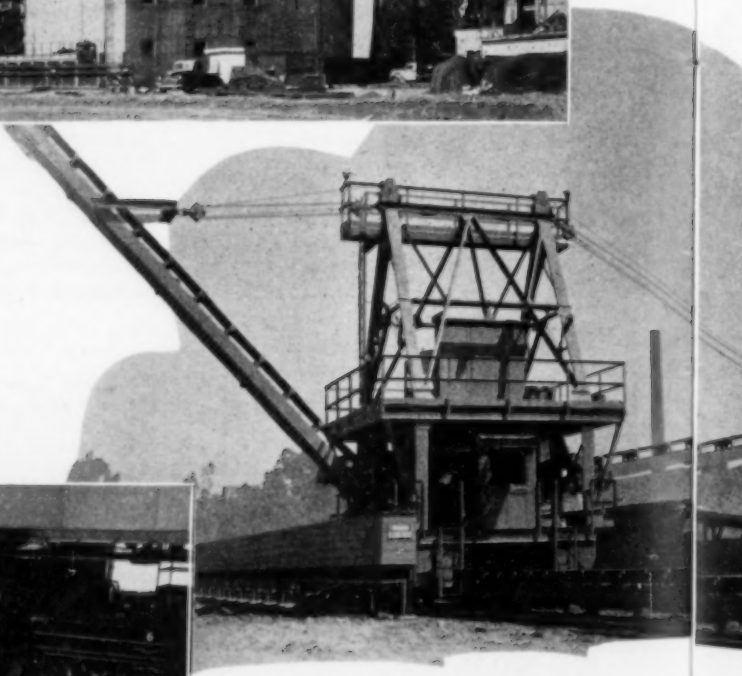
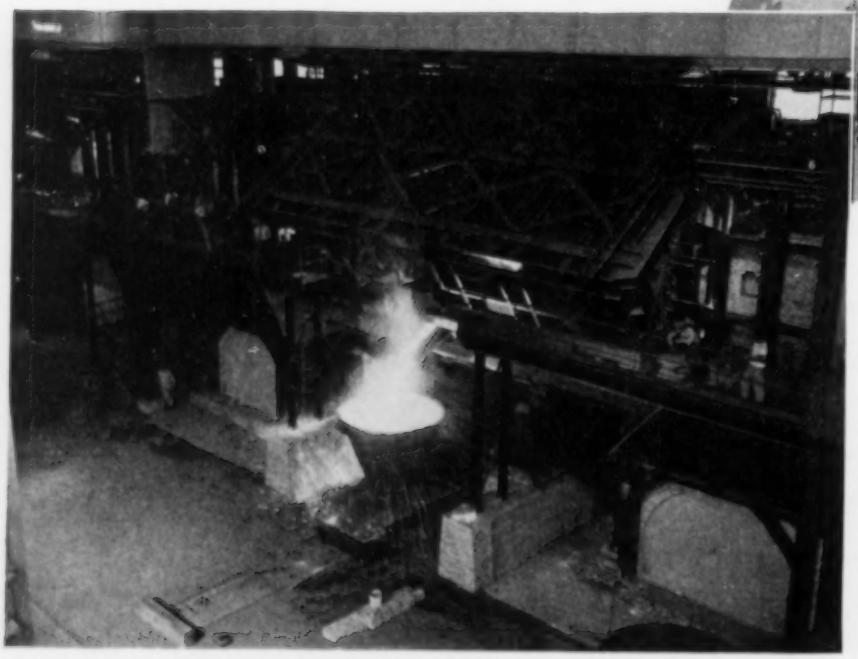


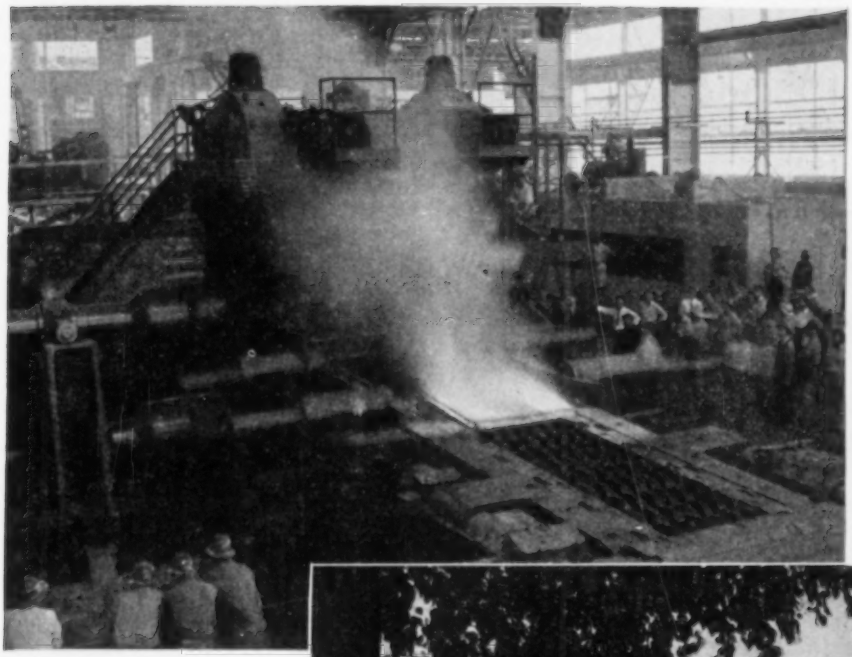
The Kaiser Steel Plant

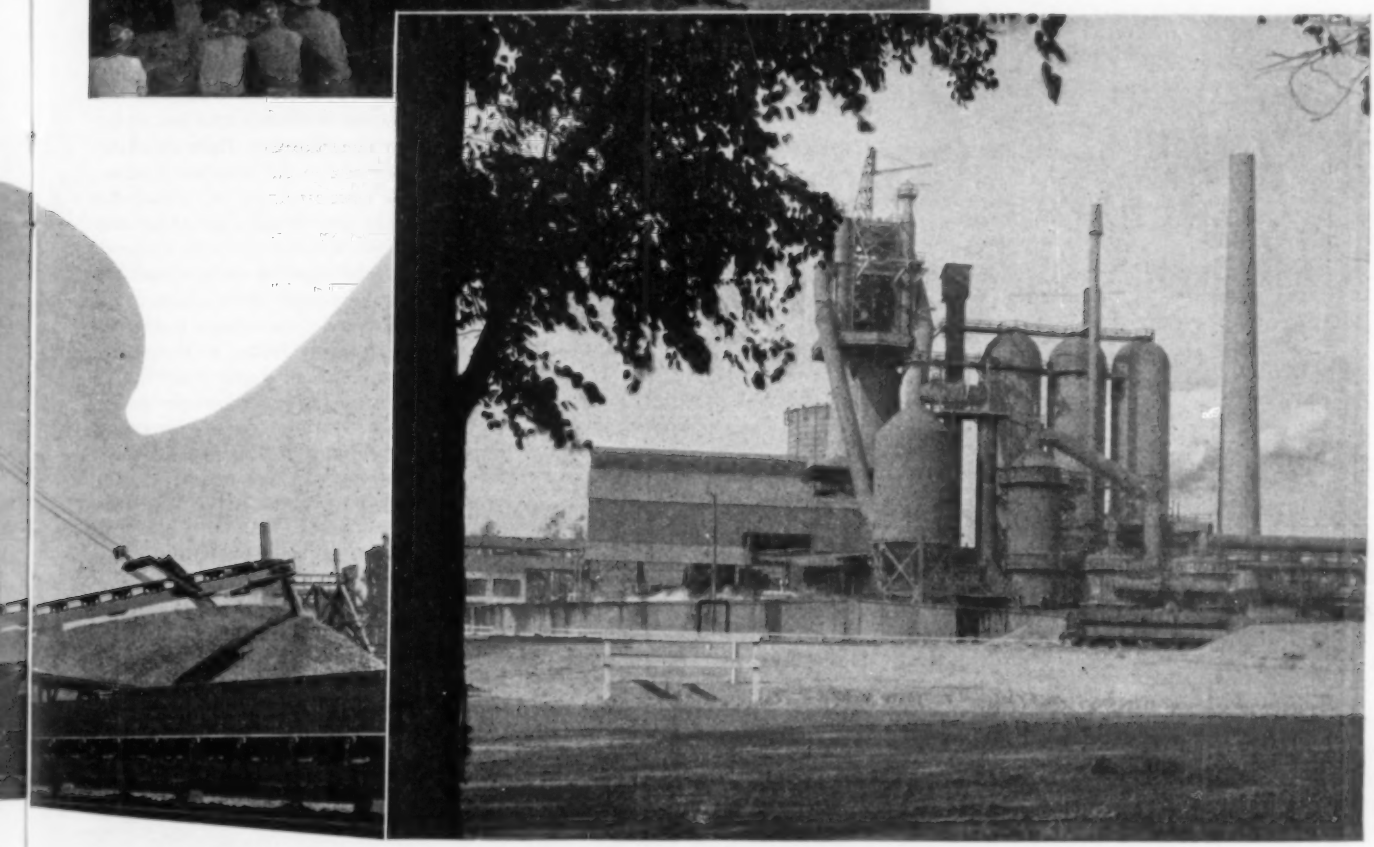
C. H. Vivian





YOUR first impression of the new steelworks of Kaiser Company, Inc., near Fontana, Calif., is that Hollywood's wizards of make-believe have been at work there. It seems incongruous to find a great industrial plant of this kind situated in the midst of citrus-fruit groves and walnut trees, miles from a city, and surrounded as far as the eyes can see by a peaceful countryside given over to orchards, vineyards, truck gardens, and chicken ranches. Add high mountains for a backdrop, sprinkle with flower-fringed lawns, and season with the balmy air of the famed southern California climate, and you've got





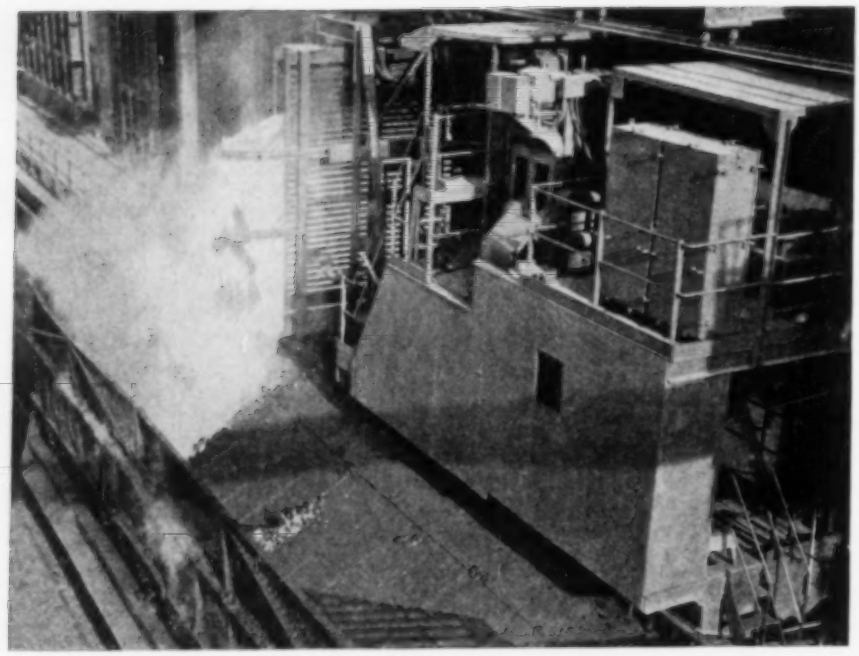
AROUND THE PLANT

A great billow of steam rises as a car of coke is quenched (top, opposite page). The picture shows the coke ovens and, at their near end, the 1800-ton-capacity concrete bin from which their coal supply is drawn. At the bottom-left, a tilting-type open-hearth furnace is discharging fiery-hot steel into a ladle car. Ore for the blast furnace is blended to a uniform mix by piling it with the traveling double-boom stacker illustrated in the center and reclaiming it afterward by slicing down through the pile. The 1200-ton blast furnace (below) is partly framed by a tree that was left undisturbed when the site was cleared. The plate mill went into operation on October 16, 1943. At the left, the first 15/16-inch plate is seen passing through the 3-roll-high finishing mill.

a picture that makes your eyes fairly blink. Yet, it's all very real and, as you will discover, all very earnest.

The Fontana plant is a dream come true, and many persons hold that it is one of the foundation stones upon which a West Coast industrial empire will rise. For many years Californians have envisioned a local source of supply of diversified steel products for their fast-growing metal-working industries, thereby relieving them of dependence upon eastern mills and reducing manufacturing costs. Nearly 40 years ago some southern California iron ore was sent to England for experimentation, but the record as to what happened to it is hazy, beyond the fact that the deposits remained undeveloped. It required a war to bring the Kaiser establishment into being, but neither its management nor informed California businessmen consider it a war baby. They are certain that it will continue to function when peace comes and cite some convincing facts to back up their opinion.

More than 14,000,000 people live in the eleven western states, half of them in California. Based on the average national steel consumption of 600 pounds a year per capita, Southern California alone can use about four times the capacity output of the Fontana works. Moreover, Californians will be in a position to bid for some types of manufacturing in which they are not now engaged. Automobiles and refrigerators are two articles they have specifically in mind, as both now involve the payment of freight charges from the East that add substantially to their retail price. Aside from the domestic market, there are good reasons to believe that there will be great postwar development in the Far East, notably in China, which will require vast quantities of steel. As the water-route distance from Los Angeles to Shanghai, via Hawaii, is 8607 miles,



COKE COMING OUT OF OVEN

After being subjected to intense heat for eighteen hours without access to air, the charge of coal has given up virtually all its volatile matter and has become essentially carbon. Doors are then removed from both ends of an oven, and the traveling machine shown here places latticed guides so that the coke can be pushed through them and into a waiting car. The pushing is done by a ram on the opposite side of the bank of ovens. When it reaches the open air, the coke bursts into flames and is transported immediately to the quenching station.

as compared with 12,707 miles from Baltimore to Shanghai, the Kaiser plant obviously has the advantage.

The Kaiser mill is the only integrated steelworks on the Pacific Coast. Pig iron was produced in 6-ton lots as early as 1867 in the State of Oregon, and some bar steel was rolled in 1909 at Irondale, Wash. At various points along the coast are plants that turn out steel products of different kinds, but the Fontana establishment is the first that affords complete facilities for making finished steel from iron ore. Its present principal function is to supply plates to shipbuilding yards, but it is designed ultimately to manufacture a diversified line of both carbon steel and alloy steel.

The Fontana plant was financed by secured loans obtained by Kaiser Company, Inc., from the Reconstruction Finance Corporation, and will represent an outlay of around $90,000,000 in the finished state. Its construction was marked by outstanding speed, as ground was broken on April 6, 1942, and the first iron was made less than nine months later, on January 1, 1943. The first steel ingot was poured on May 14, 1943, and the first plate rolled on October 16. Nearing completion are structural and merchant mills, which are scheduled to go into operation in June. Considering that the project was undertaken by an organization with no previous experience in the steel business at a time when thousands of war plants were competing for material and that the site was far removed from the eastern factories from which most of the machinery had to come, the accomplishment looms large. An army of expediters maintained contact with suppliers to see that delivery dates were met. Actual construction was divided into numerous contracts, and Kaiser Company, Inc., also did considerable work itself. At the peak of activities, 5800 men were employed. To avoid drawing on our store of critical materials, substitutes were utilized wherever possible. For example, concrete was used for bins, for many building walls, and for most of the chimneys. Because the plant is near a fault line which has been the cause of minor earthquakes, the foundations of most of the structures were designed with a seismic coefficient of plus 10 percent. This was increased to 25 percent for chimneys.

In erecting the works, care was taken to disturb the natural setting as little as possible. This was carried so far as to leave intact rows of eucalyptus trees that run east and west at regular intervals and serve to break the prevailing north winds. Similar regard for appearances has been displayed by landscaping the premises, by sowing grass in every available space and setting out flowering plants obtained from hotbeds on the grounds. These aesthetic touches never fail to evoke comment from visiting eastern steel men. All possible precautions have been taken to eliminate smoke, dust, and fumes, and Fontana residents bear witness to their success. As a safeguard against contamination, water from the phenol stills of the coke-oven by-products department is chemically treated before being wasted. Of the 1300 acres of land purchased, 550 acres is being utilized for plant purposes. The remainder is in orchards, vineyards, hayfields, and truck gardens and is more than paying its way, besides furnishing fresh fruits and vegetables for the company cafeteria.

While the plant was under construc-

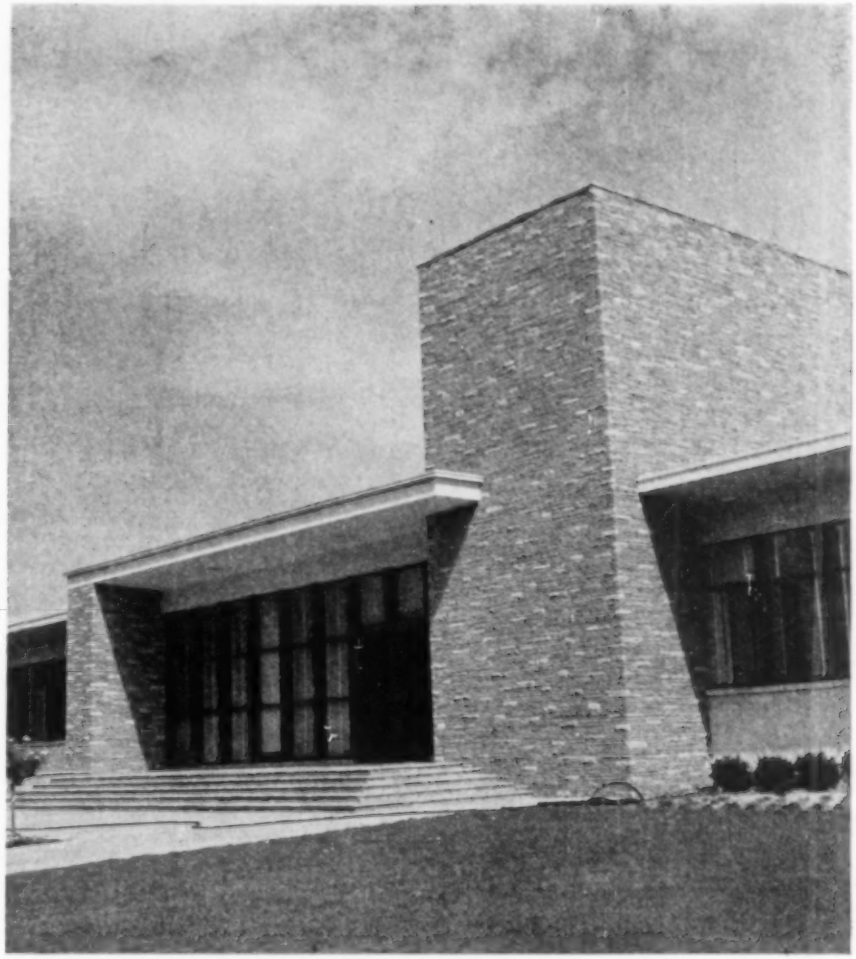
A VERDANT SETTING FOR INDUSTRY

A view of the plant from a distance, looking across cultivated fields. At the right is a row of eucalyptus trees, one of many planted in this section to serve as windbreaks. The site is near Fontana, about 50 miles from Los Angeles. There is ample land available for the extension of the steelworks or for the construction of industries that can make use of some of the steel products.

tion, it was necessary to develop sources of supply of iron ore, coal, limestone, dolomite, and manganese ore. Iron ore, running approximately 52 percent iron, is obtained from the Vulcan Mine near Kelso, Calif. Although it is 175 miles from Fontana, both are in the same county, San Bernardino, which bears the distinction of being the biggest county in the United States. (It is larger by 3594 square miles than Massachusetts, Rhode Island, Delaware, and Connecticut combined.) Coal comes from a mine at Sunnyside, Carbon County, Utah, which is operated under lease from the Utah Fuel Company; limestone is purchased at Colton, less than 10 miles from the plant; dolomite is obtained from deposits at Sloan, Nev., and Salinas, Calif.; and manganese, for use in the open-hearth furnaces, is produced in southern California and Arizona.

Coke for blast-furnace fuel is made in 90 ovens, and from the gas driven off in the process various useful products are recovered in an auxiliary plant. Iron is produced in a blast furnace with a daily rated capacity of 1200 tons and is refined into steel in six basic open-hearth furnaces, the resultant steel ingots being converted into divers commercial products. There is a 110-inch mill for rolling plates, a 36-inch breakdown and a 28-inch mill for rolling structural shapes, and an 18- and 14-inch mill for rolling shapes and bars from carbon or high-alloy steel. Supplementing these principal facilities is a vast array of machinery and structures for aiding and controlling the production processes, for handling utilities, and for repairing and servicing equipment.

The annual rated capacity of the plant is 432,000 tons of pig iron and 675,000 tons of steel ingots made up of 450,000 tons of carbon steel and 225,000 tons of alloy steel, the ratio depending upon market demands. There is sufficient mill capacity for turning out 300,000 tons of sheared plates from ¼ inch to 2 inches thick, 96 inches wide, and up to 40 feet long; 90,000 tons of structural shapes such as angles, channels, and beams; and 82,000 tons of small merchant shapes and bars. The annual output of coke-oven by-products will include 1,600,000 gallons of benzol, of use as a solvent and in making synthetic rubber; 428,000 gallons of toluol, an ingredient of TNT; 300,000 gallons of xylol and naphtha, of service as solvents and in the chemical industry; 3,768,000 gallons of creosote oil, a wood preservative; 754,000 gallons of residue fuel oil which is consumed in the plant; 18,000 tons of pitch which likewise serves as plant fuel; 375,000 pounds of sodium phenolate, of use in the plastics and chemical fields; and 9120 tons of ammonium sulphate, a fertilizer. A by-product of the blast furnace will be 250,000 tons of slag that can be utilized as concrete aggregate, as roadbed ballast, or for making rock-wool products.



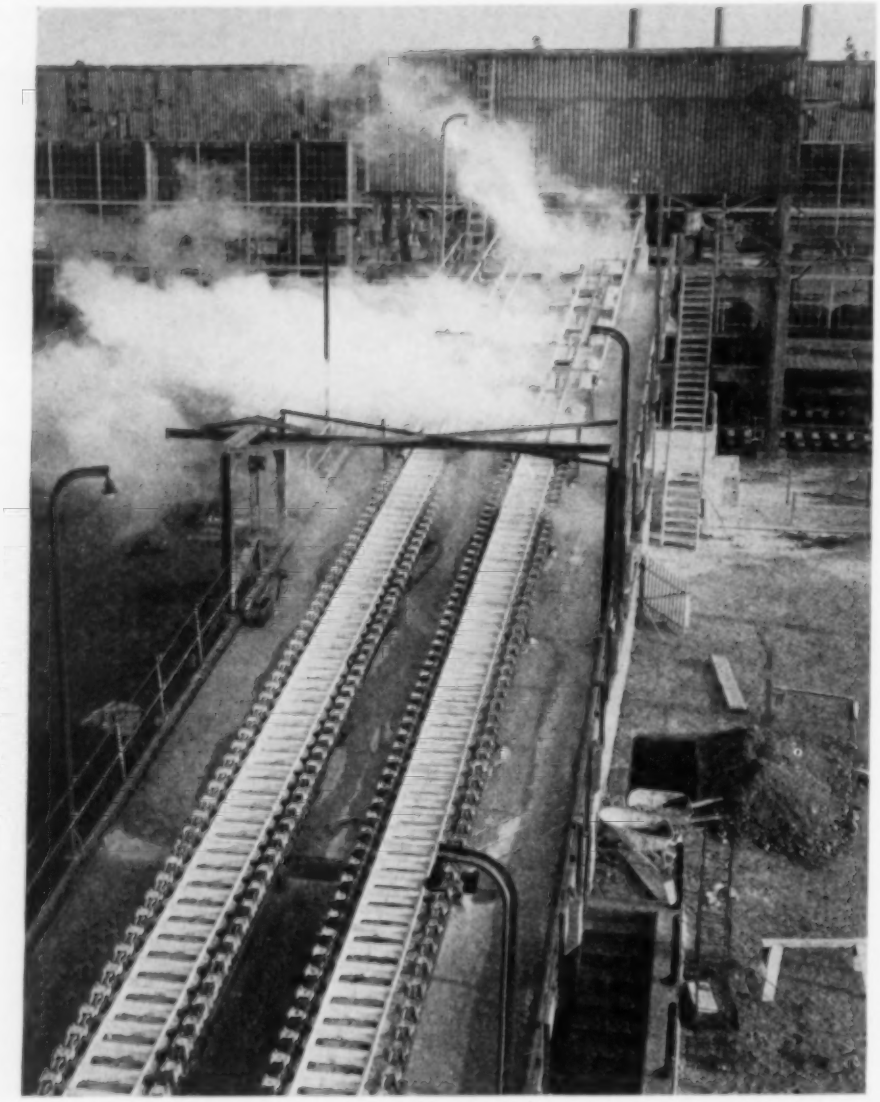
ENTRANCE TO OFFICE BUILDING

General offices are housed in a Spanish-type, 1-story structure built in the form of a rectangle, with a lawn and flowers and a central fountain adorning the inner court. The masonry work shown here is made up of thin slabs of buff sandstone that are quarried nearby.

As a natural result of Henry J. Kaiser's experience in moving concrete materials by belt conveyors on western contracting jobs, there are 3½ miles of belts in the plant transportation system. Iron ore is received in bottom-dump railroad cars and emptied into hoppers under the tracks. From there it is moved by belt to a crusher building, where it is reduced to a maximum of 3 inches and screened to three sizes: 3 inches to ¾ inch; ¾ to ⅜ inch; and less than ⅜ inch. The two larger sizes are charged directly into the blast furnace, but are first blended to insure uniformity. This is done by means of Robins-Messiter bedding apparatus, which is shown in an accompanying illustration. Space is available for four beds, each containing 12,000 tons of ore, and a supply of 100,000 tons of raw ore is maintained in case shipments from the mine should be interrupted.

The fine ore from the screening plant is conveyed to a sintering machine, where it is fused with coke dust, flue dust, and scale from the plate mill to provide a material coarse and strong enough for blast-furnace use. The mixture is spread from 8 to 10 inches thick on a traveling grate 6 feet wide and 102 feet long. The top of the layer is ignited by a coke-gas flame playing on it from above; and as the material moves along, suction applied underneath draws air through it and gradually extends the burning zone downward until the entire mass is incandescent. At the end of the grate's travel the sinter is quenched and broken and then chuted out of the building to a storage pile. A conveyor belt beneath the pile transports the material to the blast furnace as needed.

Coal is similarly unloaded and moved by belt to a junction house, from which it goes either to outside storage or to a main coal bin. The practice is to maintain a stockpile of 30,000 tons and to withdraw enough from the oldest section to provide a half-and-half mixture of stored and newly received coal for current use. Consequently, no coal is held in storage longer than 30 days, and this



PIG-CASTING MACHINE

Surplus molten iron from the blast furnace is cast into pigs by pouring it in molds in this endless, inclined, moving, double line. Near the top of the slope a water spray cools the pigs, which fall into cars as the molds reach the apex of their travel and turn over. The pigs are either sold as merchant iron or are charged into the open-hearth furnaces.

prevents slacking and spontaneous combustion. The mixed coal is carried to a breaker, reduced to a maximum size of 1¾ inches, and then passes to a hammer mill where it is pulverized so that 50 percent of it will drop through a ⅛-inch screen. It is then conveyed to an 1800-ton bin that supplies the coke ovens. Limestone is likewise unloaded and delivered to a crusher and then to a stockpile from which vibrating units feed it on to a belt that transports it to the blast furnace.

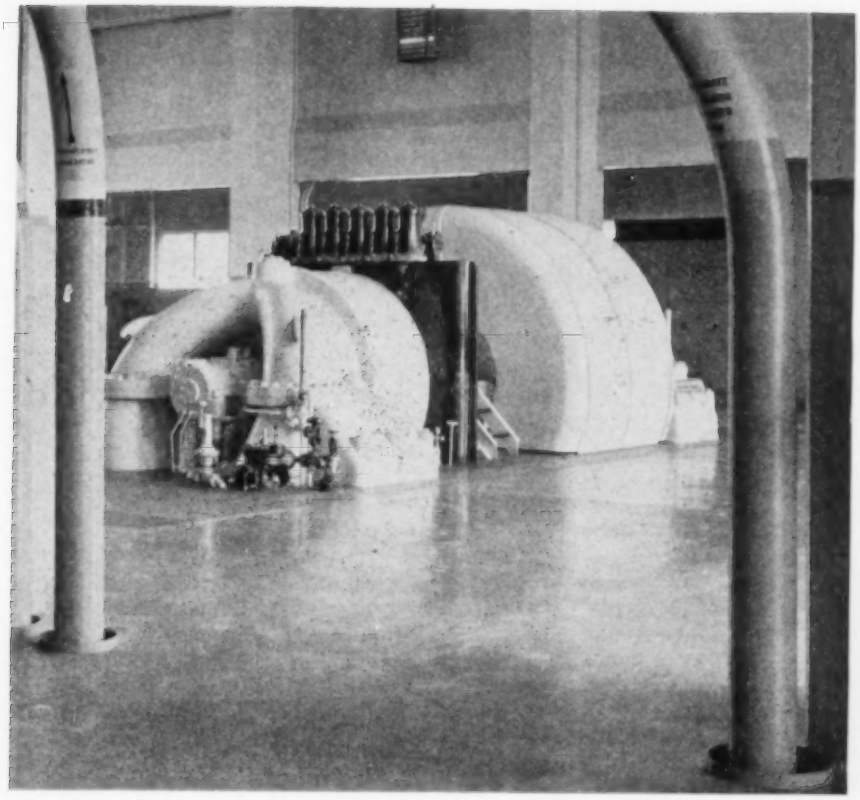
The coke ovens are of the Koppers-Becker type. Each measures 40 by 14 feet by 14 inches inside and holds 14.4 tons of coal, which is charged into the top by a larry that receives its load from the 1800-ton bin. The ovens are underfired and can be fueled either with coke-oven or blast-furnace gas. At each end of each oven is a standpipe or take-off which delivers the gas driven off during coking to a collecting main, of which there is one along each side of the battery of ovens. These two mains gather the gas from all the ovens and then join to form one pipe leading to the by-products plant. After the by-products are removed, the gas has a heating value of around 570 Btu's per cubic foot and is used as fuel.

The coking period is eighteen hours, and the 90 ovens therefore produce 120 ovens of coke within 24 hours. The daily coal consumption is 1728 tons, which yields 1058 tons of coke consisting of 933 tons of blast-furnace size, 52 tons of nut size, and 73 tons of fines, or breeze. The coke from an oven is discharged in the incandescent state into a railroad car which is pushed to the quenching station and sprayed with 800 gallons of water. Next, the fuel is dumped on to a sloping "wharf" and, after cooling for 30 minutes, is passed to screens which provide the three grades just mentioned. The coke for the blast furnace is belt-conveyed, and the two smaller sizes are loaded into railroad cars for disposal.

The blast furnace is 97½ feet high and has a hearth diameter of 25½ feet. Although its rating is 1200 tons daily, it has produced 1308 tons of iron in 24 hours. The raw materials—iron ore, coke, sinter, and limestone—are withdrawn from bins into a scale car that weighs the contents, and then dumped into a skip-hoist car for charging into the top of the furnace. There are two such cars, balanced so that one descends the steeply sloping tracks as the other goes up. Each has a capacity of 200 cubic feet and holds approximately 4800 pounds of coke or 13,600 pounds of iron ore.

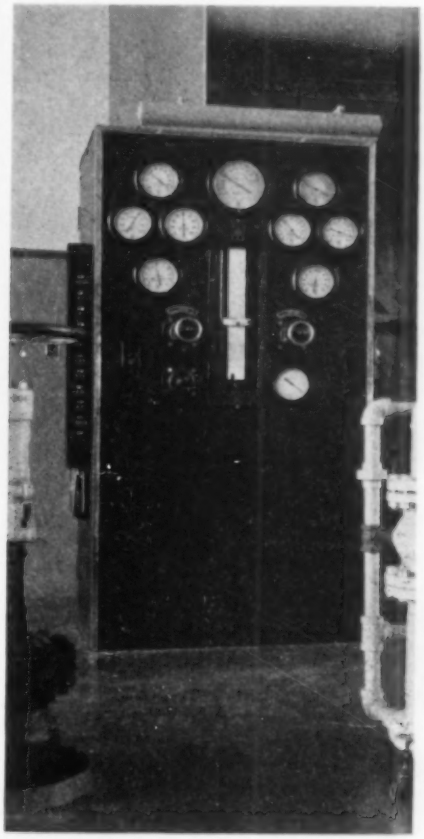
To prevent gas from escaping during the charging process, the materials are charged through a double air lock consisting of two bells, one directly above the other. The load drops on the top bell, and after the latter has been rotated to distribute the materials evenly around the perimeter it is lowered, permitting the charge to fall on the second one. The upper bell is next raised to its original position, thus forming a gastight seal. The bottom bell is then lowered to drop the charge into the furnace, and when it is returned to its starting point it acts as a valve that closes the furnace top while the upper bell is in the "down" position.

For each ton of iron, the furnace also produces about ½ ton of slag and 6 tons of gas. The gas passes out at the top and thence through a dust catcher, a scrubber, and finally a pair of electric precipitators for further removal of dust. Some of the gas goes to one of three hot-blast stoves that preheat the blast air for the furnace. These stoves are cylindrical steel vessels about 100 feet high and filled with refractory brick arranged in checkerboard fashion. The gas is burned at the bottom, and the flames and combustion products pass up through a combustion chamber and then down through the brickwork, heating it to around 1800°F. At that point the burners are turned off, and the blast air, coming from one of two turboblowers in the powerhouse, is directed through the maze of bricks where it absorbs heat before entering the furnace. By using the stoves alternately, the air is heated continuously. The blast-furnace gas not burned in the stoves serves as fuel elsewhere in the plant. It has a heating value of 85-90 Btu's per cubic foot. For each ton of iron made, about 4 tons of air is blown through the furnace to aid combustion. This air is transmitted from the blower through a 48-inch line and, after being heated, is admitted into the furnace near the base through six-



TURBOBLOWER

From the compact machine at the left comes the "wind" that blows the blast furnace. At the near end is its 11,500-hp. steam-turbine driver. The blower can deliver 100,000 cubic feet of air per minute and is designed for a maximum discharge pressure of 30 pounds per square inch. There is another blower installation of like capacity, but it can operate at a discharge pressure of 35 pounds. Below is the blower instrument board.



teen tuyeres equispaced around its circumference.

Slag is drawn from the surface of the molten iron at frequent intervals, and the iron is tapped four or five times every 24 hours in "casts" of 200 to 250 tons. The metal flows into a torpedoshaped, insulated railroad car and retains most of its heat for 50 hours. Most of it normally goes to the open-hearth furnaces for making steel, while some is delivered to the plant foundry for pouring necessary molds and other castings. Any surplus reaches a pig-casting machine, which consists of two continuous, inclined lines of molds 168 feet long. Pigs of either 30- or 60-pound size are poured at the bottom of the slope and cool as they are carried upward, falling directly into railroad cars as the molds turn over at the top.

The open-hearth-furnace plant occupies a space of 389x700 feet, all under one roof. Five of the six open-hearths are stationary and the sixth is of the tilting type and will be used later to supply metal for making alloy steel in an electric furnace that is to be installed. The open-hearth-furnace charge normally consists of from 50 to 60 percent molten iron, of 35 to 45 percent scrap, and of 5 percent pig iron, the proportions of molten iron and scrap depending upon the availability of the latter. Molten iron from the blast furnace is transferred to an 800-ton hot-metal mixer stationed at one end of the building and is withdrawn in 90-ton ladles for charging into the open hearths. Two 125-ton overhead traveling cranes serve the charging floor, and solid materials are placed in each furnace through five doors by two charging machines. Ordinarily, dolomite is first spread upon the magnesite furnace bottom to produce a basic slag. On top of this goes the scrap, and then the pig iron. After the desired temperature has been reached, the molten iron from the blast furnace is poured in. Near or at the end of the heat may be added ferromanganese or spiegeleisen.

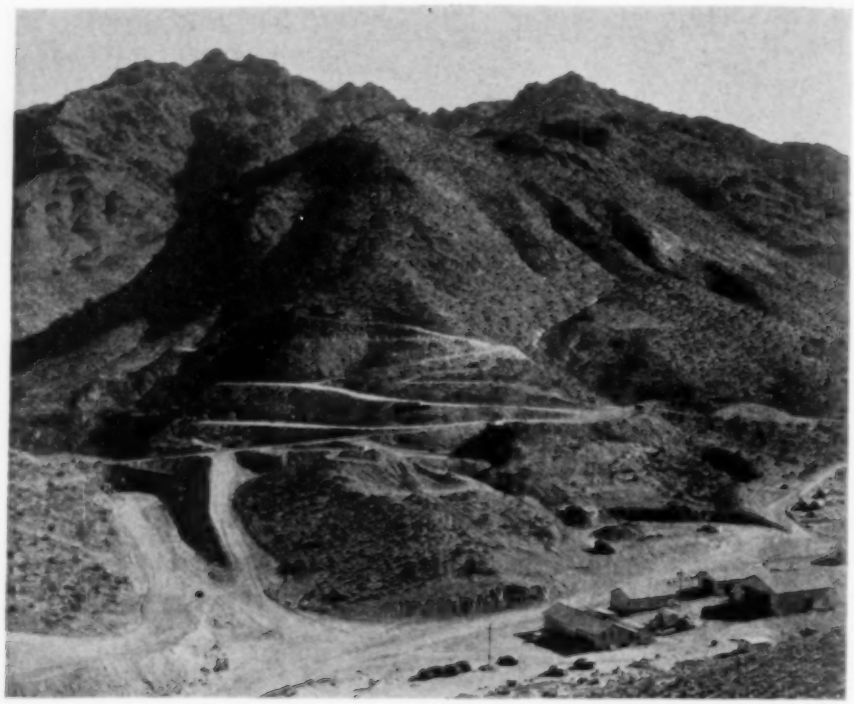
The open-hearth furnaces are fired with a mixture of fuel oil and coke-oven gas. The flame is directed across the top of the charge, and the hot gases go down through brick checkerwork at the opposite end. After fifteen minutes, the first burners are cut off and those at the other end are turned on. The air for combustion is then preheated by drawing it up through the hot brickwork. This alternation is continued to the end of the heat. From the checkerwork chambers the products of combustion pass to a stack of which there are six each 175 feet high and 13½ feet in internal diameter at the bottom. Prior to entering a stack, the gases from two of the furnaces flow through waste-heat boilers that develop steam at 175 pounds pressure and at 425°F.

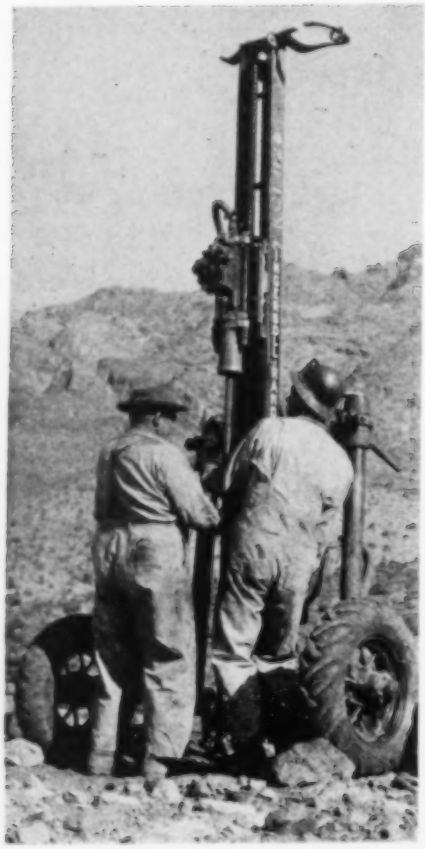
The temperature in the furnaces reaches a maximum of around 3000°F. From 8 to 9 hours is normally required to complete a heat of steel, although a heat has been finished in this mill in 7 hours and 18 minutes. The furnace tapping floor is opposite the charging floor and at a lower level. The molten steel flows out of the tap hole into a 200-ton ladle that is handled by an overhead traveling crane, and from the ladle it is poured into ingot molds. Bottom-pouring through a so-called fountain that distributes the metal to 4 or 6 molds is the usual procedure, although some ingots are top-poured for special reasons. Ingots range from 3 to 8 tons each.

As soon as the outside metal has cooled or solidified, the ingots are transported outdoors, stripped from their molds, and then either placed in storage or taken to the soaking pits that supply the plate mill. There are six of these pits fired with coke-gas fuel, and in them the ingots are brought to an even temperature of approximately 2250°F. to condition them for rolling. Each pit holds from 50 to 70 tons, depending upon the size of the ingots, which are handled by huge tongs suspended from an overhead traveling crane. When removed from a pit, an ingot is transferred to a small flat car and moved to the entrance of the mill where it is pushed by means of a mechanical arm on to a roller conveyor that

SOURCE OF IRON ORE

The Vulcan Mine, near Kelso, Calif., which has been equipped to produce around 2500 tons a day, is shown at the right. It is an open-pit mine and is being developed by means of 50-foot-high benches which are started by drilling with wagon drills (below). After being blasted, ore is loaded by 2½-yard diesel shovels into 10-ton trucks, hauled to a primary crushing plant to be reduced in size to 10 inches and under, and is then transported 9 miles to Kelso in 25-ton trailer trucks for loading into railroad cars. About 100 men are employed at the mine. Facilities provided for their care include two dormitories and a dining hall. The deposit now being worked contains only a 3-year supply of ore for the blast furnace, but there are other extensive and as yet untouched ore beds within 300 miles of the plant.





delivers it to the first stand of rolls.

In the plate mill an ingot receives its preliminary reduction by passing it back and forth through a 2-roll-high roughing mill each roll of which is driven by a G-E 3500-hp. motor. It then goes to a 3-roll-high finishing mill operated by a G-E 7000-hp. motor having a speed range of 40 to 120 rpm. To insure commercially flat plate, the ingot next passes through leveling rolls. After it is partially cooled, it is trimmed to make the sides parallel and sheared into plate sections of the desired length. Plate more than 1 inch thick is trimmed by a special machine, called a radiograph, which utilizes an oxyacetylene torch for cutting. The plates move through these various steps on motor-operated roller conveyors and are inspected several times during their travel. Finished plates are again inspected, weighed, stamped, and loaded into flat cars for shipment.

The structural mill is being equipped with a 36-inch reversing mill to roll ingots into steel blanks, blooms, and billets that will be converted into standard structural shapes in three stands of 29-inch rolls. Some of the billets will go to the 18- and 14-inch merchant mill for rolling into bars, squares, flats, standard beams, channels, and angles, as well as into strip from .110 to ½-inch gauge and up to 16 inches wide. The merchant mill will be capable of rolling either plain carbon or alloy steels, which latter will be suitable for automobile manufacture. It will also include a wire- or rod-drawing department.

There is a total of about 40,000 horsepower of motors in the plant. Electric current is purchased from the Southern California Edison Company and is transmitted to a substation on the property over a 3-way line at 69,000 volts. It is reduced to 6900 volts and distributed mostly by underground lead-sheathed cables. In the powerhouse are two 1000-kw. motor-generator sets that convert alternating into direct current for operating cranes, electromagnets, etc., in the blast-furnace, coke-plant, and open-hearth areas. Other conversion sets in the rolling mills furnish direct current for motors installed there.

The principal steam supply comes from three Babcock & Wilcox boilers in the power station. Each is rated at 120,000 pounds per hour at 400-450 pounds pressure and 700-750°F. and is arranged for firing by blast-furnace gas, coke-oven gas, or oil, the first fuel being normally used. The steam serves to operate auxiliaries in the powerhouse, coke-plant, and blast-furnace zones. Chief among these units are the two Ingersoll-Rand turbo-blowers that furnish blowing air for the blast furnace. Only one is required at a time, the other serving as a spare in accordance with general steel-mill practice.

Both blowers are rated at 100,000 cfm., but one is designed for a maximum discharge pressure of 30 pounds and the other for 35 pounds. The first unit has four stages and is driven by a 12-stage, 11,500-hp. condensing turbine while the 35-pound machine has five stages and its turbine driver delivers 12,600 hp. In setting up the blowers, some special construction features were used as a protection against earthquakes; and as a safeguard against damaging particles of dust that might be drawn into the blowers during occasional dust storms, the air is passed through Westinghouse Precipitron cleaners built in a special chamber or room interposed in the 66-inch intake lines. Experience indicates that a blast pressure of 20 pounds may be considered normal for the average condition under which the blast furnace will operate.

The turbine of each blower is served by an Ingersoll-Rand 2-pass, vertically divided surface condenser designed to maintain a vacuum at the turbine exhaust outlet corresponding to an absolute pressure of 2.0 inches of mercury or less. The condenser for the 30-pound blower contains 10,000 square feet of tube surface, while the one for the 35-

pound unit has a total surface of 10,450 square feet. Cooling water to effect condensation is circulated through each condenser by an Ingersoll-Rand centrifugal pump that can deliver 12,300 gpm. against 70 feet of head. Two of these pumps are provided, the one normally used being driven through gears by an Elliott 247-hp. steam turbine and the other, which is a standby, by a 250-hp. motor. Condensate is handled by two I-R centrifugal pumps each rated at 200 gpm. against a head of 170 feet. One is turbine-driven and the other motor-driven.

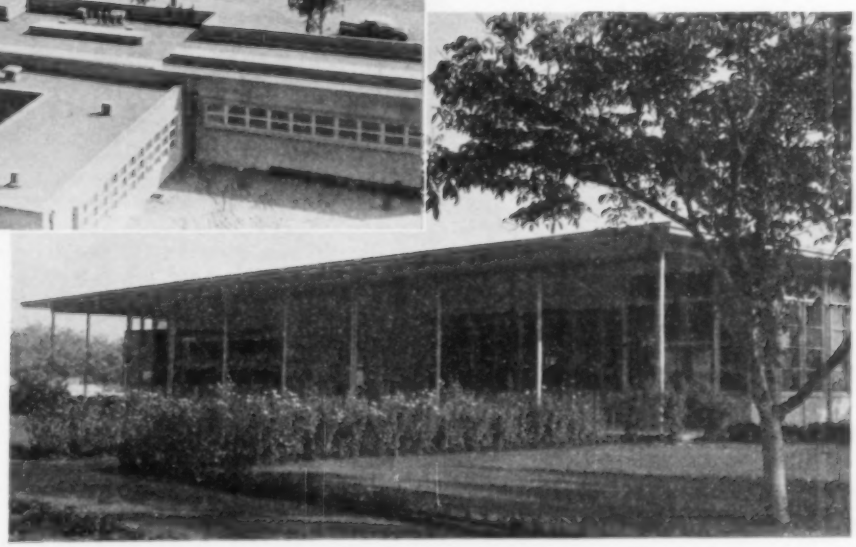
Aside from a relatively small yield from two wells on the property, the water needed in the plant is purchased from the local distributing company. As it is piped a considerable distance from mountain sources and is limited in quantity, it is comparatively expensive and therefore conserved where possible. Several large-capacity wooden cooling towers scattered about the plant cool water that has become heated during its cycle of use. Waste water from various plant areas, offices, and the cafeteria, and even the effluent from the sewage-disposal plant, are returned to the industrial system, clarified, softened, and reused. The only water that is not recirculated is that used for quenching coke and for cooling pig iron after it is cast. From 5 to 10 percent of the daily requirement is lost through these applications, as well as evaporation, leakage, etc., and an equal quantity of make-up water is added to the system. The Metropolitan Aqueduct that carries Colorado River water to the Los Angeles district passes close to the property and has been tapped to give service if and when needed.

In addition to the main plant structures mentioned there are numerous auxiliary, service, laboratory, and office buildings, many of which have walls of reinforced concrete. Among the service buildings are a 100x304-foot machine shop; a 100x204-foot pipe, boiler, and forge shop; a 64x128-foot electrical shop; an 80x300-foot warehouse; and a 60x60-foot garage. There is a 60-bed hospital, a men's dormitory with accommodations for 140 persons, and an automobile-trailer court with all conveniences, including a playground for children. Adjacent to the various working areas are locker rooms for employees and tiled shower baths.

When the plant was set in operation, approximately 10 percent of the keymen were obtained from other steel-producing areas and these men organized the working forces in the different departments. Many of the employees were recruited from the ranks of white-collar workers, and it is reported that they were easy to train because they knew nothing about their jobs to start with and consequently had no preconceived ideas. A few women are employed chiefly as inspectors and for cleaning. When functioning at full capacity, the plant will have a payroll of approximately 2500. Its location and the surrounding country are such as to encourage workers to buy land for home building and raising orchard or field crops. At present, the average person travels 22 miles daily to and from work. There is no evidence of industrialization in the vicinity of the plant, and its coming has had little visible effect on Fontana, a few miles away. So far there is not even a bus line running to the works.

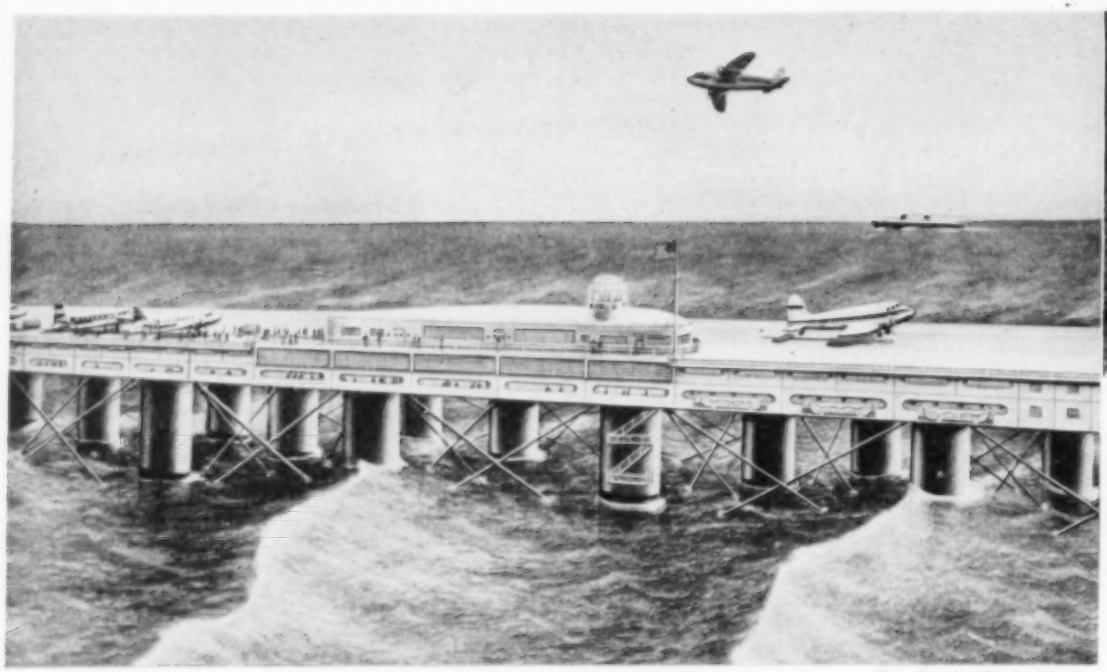
The plant is operated by the Iron & Steel Division of Kaiser Company, Inc., and engineers of the latter organization were in general charge of its design and construction. Among the primary contractors were: Bechtel-McCone-Parsons Corporation, which designed and built the powerhouse; The Koppers Company, which designed and erected the coke ovens and by-products plant; Loftus Engineering Company, which constructed the open-hearth furnaces; Open Hearth Combustion Company, which designed the open-hearth furnaces and acted as consultant on the open-hearth building; Amsler-Morton Company, which designed and built the soaking furnaces; Lewis Foundry & Machine Company, which furnished rolling equipment for the plate mill; and Mesta Machine Company, which built the rolling equipment for the structural and merchant mills.

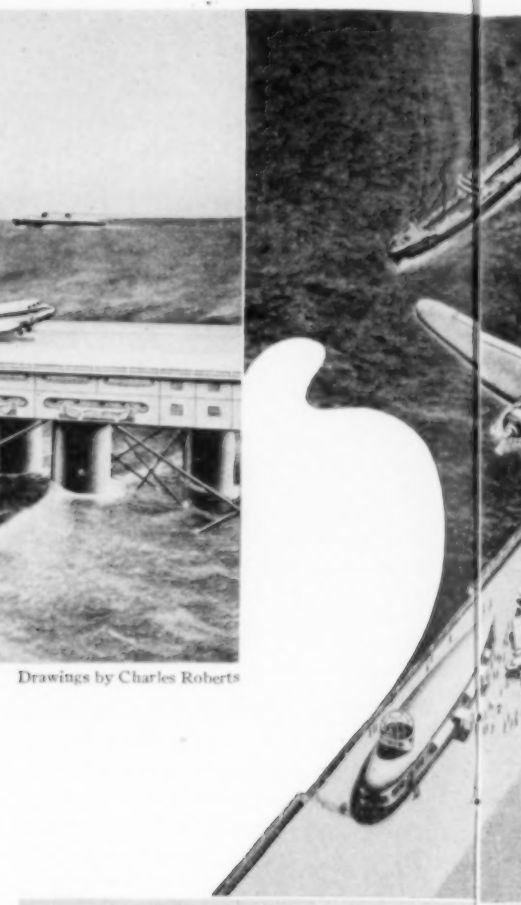
The plant organization is headed by Tom Price, as general manager, and Frank Backman is general superintendent.

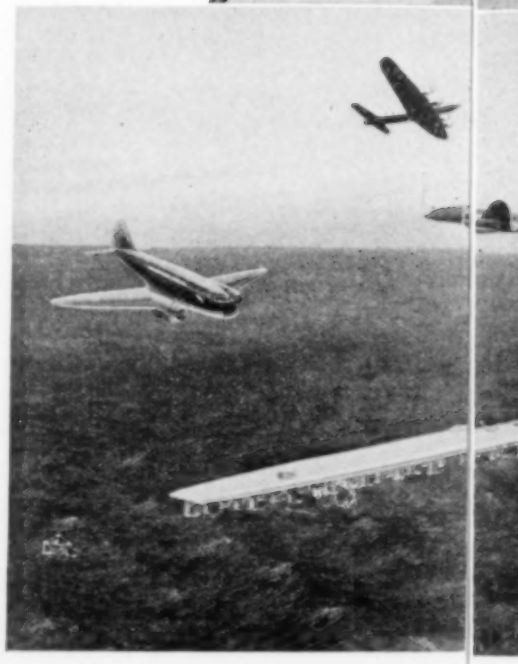


AUXILIARY STRUCTURES

Above is a group of service buildings and shops. The other picture shows the plant cafeteria in its lawn-and-flower setting.







Drawings by Charles Roberts

Airfields at Sea

Allen S. Park

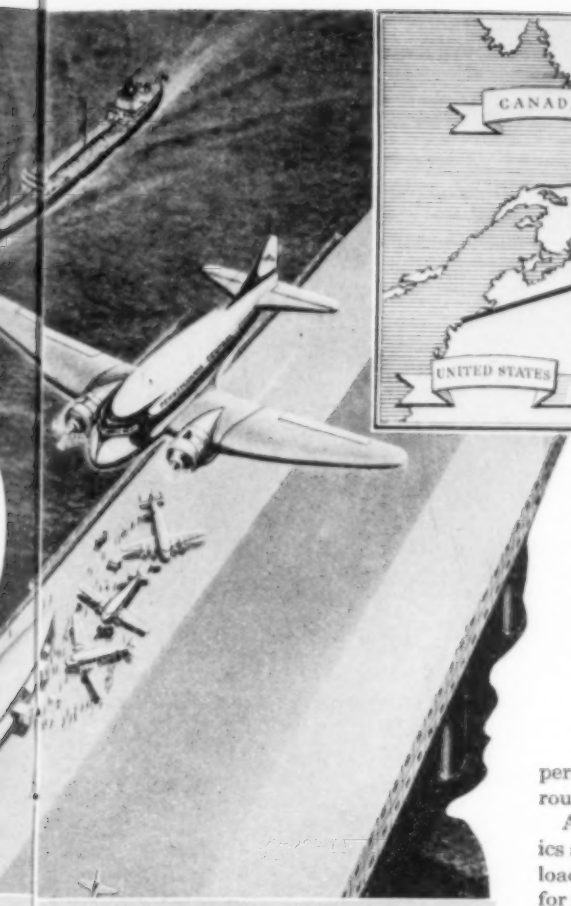
WITH transatlantic flying having become a routine matter during the war, it is taken for granted that a considerable share of the postwar intercontinental traffic will be air-borne. From a technical standpoint, there are few obstacles to prevent setting up such a service, as we now know that planes can span oceans with a satisfactory margin of safety. The economic side of the situation, however, is a bit more obscure.

Cost is not of paramount consideration during wartime, but it will again become an important factor with the return of peace. A certain percentage of the traveling public will be able to ignore it, but there are far too few persons in this class to insure airlines a paying volume of business. The rank and file of voyagers will continue to patronize surface ships if there is a great differential in fares by water and by air. Accordingly, it behooves the aviation industry to find some way of bringing costs down to where they will more nearly approximate those of steamship companies if it is to attract much traffic.

The thing that makes it expensive to fly the Atlantic is, of course, the distance that has to be covered nonstop. If there were islands conveniently scattered along the route so that planes could descend and refuel, operating costs would be comparable to those of overland flying. By the seadrome scheme it is proposed to establish such a string of floating islands, moored in place and built to withstand the effects of storms. It is not a new idea, but war-born emphasis on aviation gives it current widespread interest.

The seadrome was invented by Edward R. Armstrong of Philadelphia, Pa., who is president of the sponsoring organization, Seadrome Patents Company, Inc. Its development was started fifteen years ago, and in 1933 application was made to the Public Works Administration for a loan of $30,000,000 with which to build a series of the floating air bases for the Atlantic. The Department of Commerce approved the construction of one base as a demonstration unit and asked PWA to allot $7,000,000 for the purpose, but the money was not then available. An allocation was subsequently made, but the funds were not advanced partly because of a change in PWA policy and partly because there was a growing feeling that planes of the future would be so greatly improved that they could cross the Atlantic economically in one jump. Since that time Mr. Armstrong has enlisted the support of some of the nation's leading industrial concerns and has continued assembling engineering and economic data. His scheme was again projected into the news last May when Pennsylvania-Central Airlines filed an application with the Civil Aeronautics Board for a certificate to operate a passenger, mail, and express service between America and Europe by the seadrome system. Two months later, several other leading United States airlines gave notice of their intention to file applications for world-wide routes but made no mention of seadromes in connection with them.

As an accompanying map shows, it is proposed to establish three seadromes, at 900-mile intervals, between New York and London, thus making the trip in four hops instead of one. Mr. Armstrong claims that this would reduce the operating cost of the flight by from 200 to 400



ARTIST'S CONCEPTION OF THE SEADROME

The map shows the probable route, which has been chosen because it is relatively free from storms, icebergs, and cold. At the bottom is a general view of a seadrome with an aircraft carrier alongside. This picture gives a good idea of their difference in size. The anchoring buoy is visible beyond the left end of the floating air base. In the center is a pilot's view of a seadrome and of a tanker approaching with fuel and supplies. The other picture shows the midsection of the structure on top of which are stores, radio station, etc. Beneath the flying deck are two decks: one for the accommodation of personnel and passengers and the lower one for servicing aircraft, for storing gasoline, fuel oil, etc., and for housing machinery for lighting, pumping, and other services.

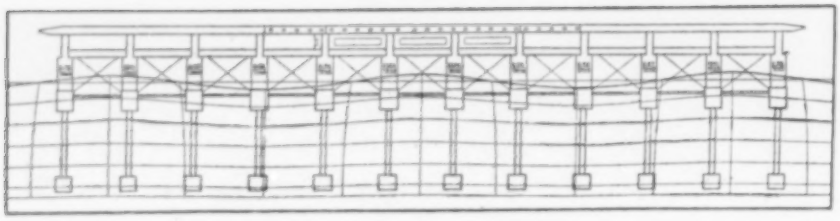
percent and increase the pay-load capacity from four to five times. These conclusions are based on the performances of Douglas DC3 planes, the type that was most generally used by American transport lines prior to the war. This is a 21-passenger, 25,000-pound plane. For 400,000,000 miles of civil air-route flying the operating cost has averaged 68 cents per flight-mile, or 27 cents per pay-load ton-mile, with 100 percent loading. These figures are for route distances of from 300 to 600 miles.

A recent report on seadrome economics sets forth that 20 percent of the gross loaded weight of such a plane is available for a pay load on a flight of 900 miles, but that the pay-load capacity is cut to 4 percent on a trip of 3600 miles. This reduction is necessary, of course, because of the additional gasoline that must be carried to sustain the longer flight. With regard to the possibility of lowering costs by building superplanes, it is said that a 50,000-pound transport will operate at a pay-load cost per ton-mile of around 24½ cents and a 250,000-pound plane at about 22½ cents, a relatively small reduction. Increasing the speed will, it is argued, increase operating costs precipitously. Mr. Armstrong states that 200 miles per hour has been established as the most acceptable speed within reasonable cost limits. If it is increased to 300 miles per hour, the pay-load cost per ton-mile will rise 300 percent, he declares. He cites the fact that fighter planes that travel 400 miles an hour can carry sufficient gasoline for only two hours' flying time.

As planned, each seadrome will be a huge, elongated, structural-steel deck supported by 70 columnar metal legs. The buoyancy of the legs will be controlled so that the deck will ride some 70 feet above sea level, beyond the reach of even the highest waves. The deck will be 3550 feet long, 400 feet wide throughout 1050 feet of its midsection, and will taper at the ends to a width of 280 feet. Each of the supporting columns will be 250 feet long and made up of four members. The upper 92 feet, most of which will be above water, will be elliptical in cross section, thus offering low resistance to wind and waves. Much of this part of the column will be exposed alternately to the air and to the sea water and will therefore be made of iron which, when properly painted, has a long life, as is proved by the existence of iron ships more than 60 years old. These streamlined legs will serve primarily as connecting members between the deck and the buoyancy tanks. Each of the latter will be a closed cylinder 38 feet deep and divided into eight watertight compartments that will be accessible for making repairs. Next below the buoyancy unit will be a cylindrical section, 92 feet long, at the lower end of which will be a ballast tank, 28 feet deep, that will be loaded with sand and water when the seadrome is anchored. The part of each column that will be underwater all the time will be made of steel and protected with paint.

When in service and under deep-draft conditions, it is estimated that the seadrome will have a displacement of 120,000 long tons. In light trim, the structure itself will weigh 60,000 tons. To this will be added 31,300 tons of water and 22,000 tons of sand in the ballast system, 3000 tons of gasoline, 2000 tons of fuel oil, 150 tons of lubricating oil, 1250 tons of fresh water, and 50 tons of drinking water. The crew, stores, etc., will probably total 250 tons.

To make it possible to construct a seadrome in relatively shallow water (28 feet draft) near the shore and to tow it to its position in the sea lane, the sections connecting the ballast tanks and the buoyancy tanks will be made to telescope into the streamlined legs between the buoyancy tanks and the deck.



LONGITUDINAL SECTION

This drawing shows the buoyancy units and ballast tanks and indicates how the columns visible above the water will be trussed together by means of cables enclosed in iron pipes.

The upper end of the retractable section will be fitted with the equivalent of a pneumatic rubber-and-fabric tire which, when inflated, will expand against the walls of the outer, enclosing member, thus forming a seal against the admission of water. At the same time it will provide a support for the retractable section and its connected ballast tank in all positions except that of complete extension, when the weight will be transferred to the top of the buoyancy tank by a metal collar located just below the tire seal. Up-and-down movement of the ballast-tank member will be controlled by admitting water to or discharging it from the ballast tank. Expulsion of the water will be effected by means of compressed air, which will permit effective, speedy, and accurate control of this function.

In similar fashion, the total buoyancy of the seadrome will be altered or equalized, as desired, by varying the amount of water in the compartmented buoyancy tanks. To make this possible, several of the eight subdivisions in each tank will have pipe connections for compressed air. In order that air may always be available for these services and to reduce the size of the compressor installation, a large air receiver will be built in the upper part of each ballast tank. With this storage capacity, it is expected that the relatively infrequent changes that will be required in buoyancy and trim can be made with a compressor plant delivering approximately 2000 cfm.

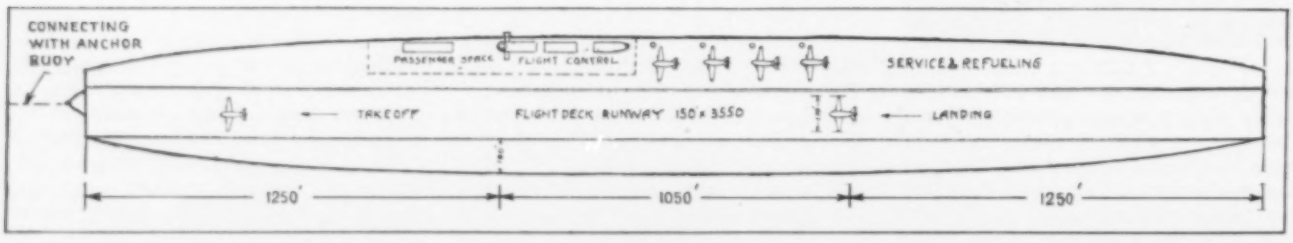
Fuel, food, and other supplies will reach the seadromes in ships and will be transferred, regardless of weather conditions, by the cable telpherage system used by the U. S. Navy for servicing vessels on the high seas. In the event of a storm, the surface of the water at the unloading point will be calmed by an air-breakwater system invented by Philip G. Brasher of Connecticut. Its operation involves the release of compressed air from perforated pipes which, in this case, will be attached to the ballast tanks and located about 170 feet below the water level. In rising surfaceward, the air breaks the continuity of the waves, thus stilling the sea within the affected area. It is not likely that the breakwater will have to function more than four or five hours at a time nor oftener than once or twice a month. The necessary compressed air will be drawn from the ballast-tank receivers.

One end of the air base will be moored to a buoy which, in turn, will be connected to an anchor on the ocean floor. The mooring system is designed to withstand a total stress of 750,000 pounds, although tests and calculations have indicated that a tension of 200,000 pounds would suffice to hold the structure against the most extreme wind and current conditions that are likely to be encountered. To supplement the anchoring gear, the seadrome will be equipped with propulsion machinery capable of furnishing a total thrust of more than 300,000 pounds, and provision will be made to disconnect the anchor cable and to keep the structure on her station by the propulsion equipment alone should an emergency make such a course expedient.

Owing to the fact that the water at the seadrome sites is so deep (12,000 to 15,000 feet) as to cause the highest-quality forged-alloy-steel chain to break of its own weight before reaching bottom, the anchoring system will call for steel cable of the suspension-bridge type that has strength enough to hold at a depth of 60,000 feet. However, a length of forged-alloy-steel chain will be used to connect the anchor with the cable because the latter would wear rapidly and also foul and kink badly if it were allowed to come in contact with the ocean bottom. The anchor will weigh 1500 tons and will be constructed so that it can be floated into position and then sunk by opening seacocks to admit water. Moreover, as an accompanying illustration shows, the cable will be coiled inside of it and will be played out as the anchor sinks at a rate to be controlled by water brakes.

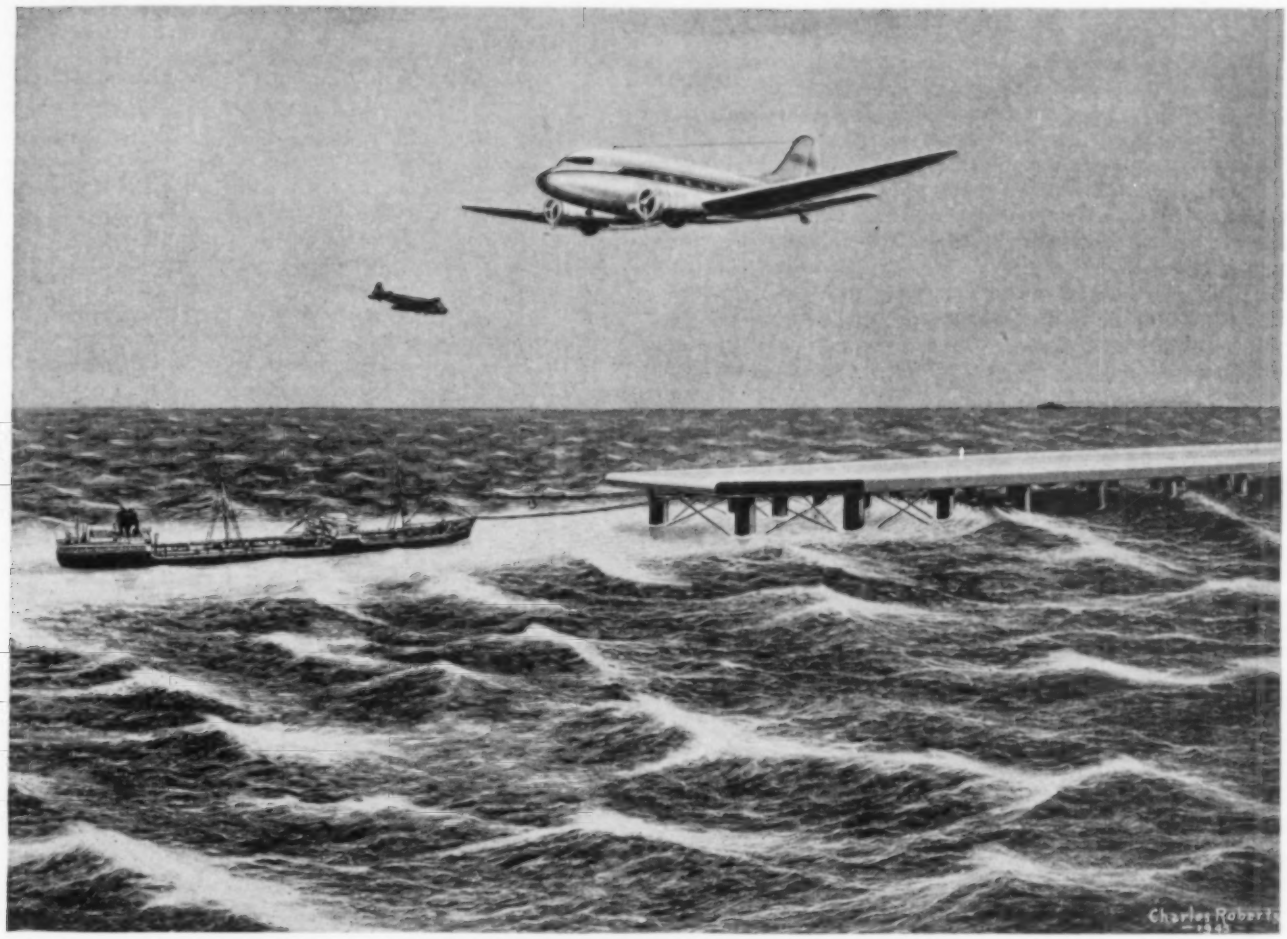
The big question regarding floating air bases is, of course: Can they be built to withstand the forces of wind and waves? Discussing the subject in a recent issue of *Flying*, Mr. Armstrong wrote: "The principles and practices of construction by which a landing field can be safely and steadily anchored in the Atlantic are derived not from tall tales by sailors, but by mathematical measurements of the waves and winds of the Atlantic and the experimental determination of the stresses they exert on any given body exposed to their effects.

"The sailor or layman begins with some confusion, because the picture in his mind is of a ship battered by waves. A ship floats on the surface of the ocean where the waves are the most active and the energy of their motion is the greatest. The relatively small size—and the great length and draft—of the individual buoyancy units of a seadrome structure, which support the landing deck high above the ocean surface beyond the reach of the greatest waves, is such that they do not appreciably break up wave motion. On the contrary, ships, by their size and bulk when underway, do break up wave motion. This energy, released by the disturbance of the waves, produces violent motion in a ship, while waves encountered by a seadrome are undisturbed and go on their way without loss of energy and, obviously, produce none of the motions of rolling, pitching,



DECK PLAN

Each seadrome will be equipped with the most modern radio equipment and aids to navigation. It is contended that it will be easier for a plane to make a blind landing on such a structure than on a regulation airfield because there will be no interference from surrounding buildings and electrical installations.



COMPRESSED-AIR BREAKWATER

A supply ship is pictured here unloading its cargo during a storm by means of a telpherage system. The vessel is riding on water that has been calmed by compressed air released from perforated pipes 170 feet below the surface. By the use of this system, which has been satisfactorily applied a number of times over a period of years, a mile-long zone of relatively quiet water can be created aft of the seadrome. The air will be drawn from receivers in the substructure.

and heaving always associated with ships under storm conditions.

"There are two very fundamental characteristics of seadrome buoyancy units theoretically inherent in the design and proved to exist by many experimental tests. The first of these—not generally appreciated by naval architects—is that a buoyant body similar to a seadrome buoyancy unit may have a considerable change in displacement without appreciable change in buoyancy. A typical seadrome buoyancy unit which may, for example, have a still-water buoyancy of 2186 tons will, under wave energy conditions associated with 30-foot-high ocean waves, have its buoyancy increased in any part of the wave to a total ranging from 2203 to 2212 tons, although, as is perfectly apparent, the units in the crest of the wave have increased and those in the trough of the wave have decreased their displacement. The 30-foot change in water level due to wave motion does not, for all practical purposes, change the buoyancy of any unit making up a seadrome structure. Thus there are no forces, released by the waves, operating to move it.

"The second important characteristic associated with seadrome buoyancy units is due to the fact that the normal motion of water in ocean waves is almost entirely a vertical up-and-down movement. While this movement results in the transmission of a wave form of great energy content, it is one that normally does not result in any horizontal transmission of the water involved in the motion. Horizontal motion of wave water results only from obstructing the normal motion of the waves. Ships do this, seadrome buoyancy units do not; hence ships are battered about by waves which would leave a seadrome structure unmoved and unstressed. Even in the highest waves in the open ocean there would be practically no movement perceptible in a seadrome structure and no impact force exerted against it.

"In addition, operating further to produce a steady structure, the first seadromes to be built will be over 3500 feet long. This is three times longer than the longest ship ever built. But, more important, it is some six times longer than the great waves of the North Atlantic. Its steadiness, even at the surface, is not dependent upon the unified action of a single wave that rolls from stem to stern, but upon a number of waves acting differently at points throughout its length and breadth, and compensating one another."

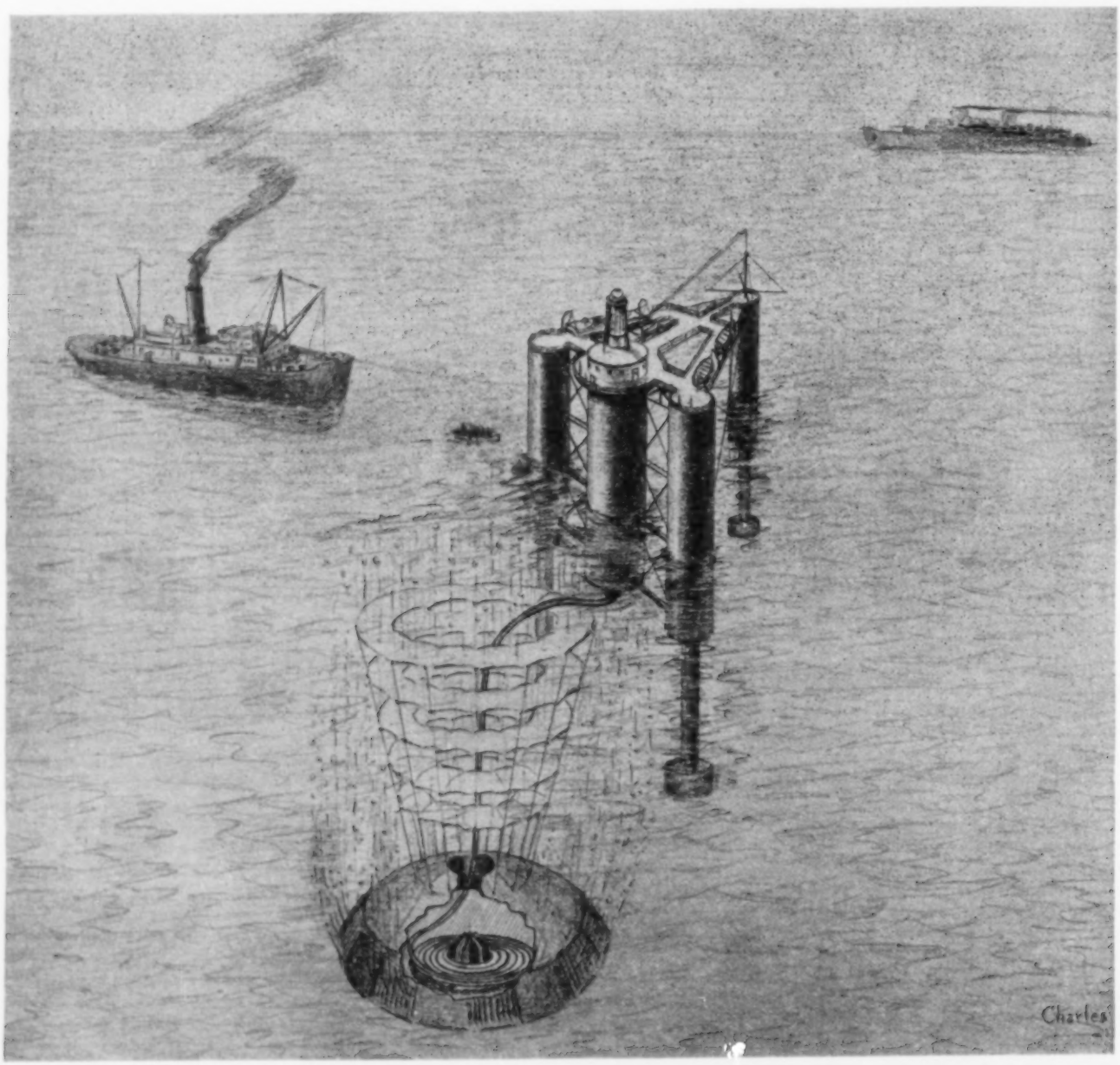
It is estimated that each seadrome will contain 60,000 tons of steel and cost about $12,500,000 in position. Three units will, then, involve an outlay of $37,500,000; and, together with the working capital, at least $40,000,000 will be required to finance the scheme. Although this is a large sum, it is pointed out that it is no more than was expended on LaGuardia Airport at New York.

In computing the economic aspects of the proposition, it has been assumed that traffic will increase gradually, and operations have been arbitrarily divided into three periods: preliminary, development, and normal. The running cost of three seadromes during the preliminary stage has been figured as $575,000 a year, and to this there have been added

$1,000,000 for insurance and $125,000 for administration and other expenses, making a total of $1,700,000.

On the income side, it has been suggested that each plane be charged a toll of five cents per rated horsepower per landing. Speaking in England last May, Edward P. Warner, vice-president of the Civil Aeronautics Board, estimated that an average of 600 passengers a day would cross the Atlantic each way during the immediate postwar years. Mr. Armstrong has used this figure in making his calculations for the development period, assuming a service of eight planes a day each way for 350 days a year and each carrying 40 passengers at 70 percent of full loading. With a power plant of four 1350-hp. engines per plane, the total daily toll would be $12,860 and the annual toll $4,536,000. Profit at the rate of five cents a gallon on gasoline and fuel oil handled is estimated at $875,000 a year, and returns from hotels, stores, weather bureaus, and radio stations on the seadromes at $436,000 annually. Together with $153,000 miscellaneous income, the gross annual receipts would amount to $6,000,000. Deducting operating expenses of $1,700,000, plus amortization of $1,875,000 (at the rate of 5 percent), leaves an indicated surplus of $2,425,000.

For the preliminary period, which is assumed to be one year, the foregoing estimated income has been halved, making it $3,000,000. Subtracting from this the sum of $1,700,000 (no amortization or depreciation is provided for during this period), the indicated surplus is $1,300.000. For the normal period (beginning with the fourth year) 48 daily trips have been envisioned, with an airbase landing every 30 minutes. The gross income on that basis would be $15,000,000, insuring a substantial profit. Only one-third of the estimated capacity of each seadrome would then be in use.

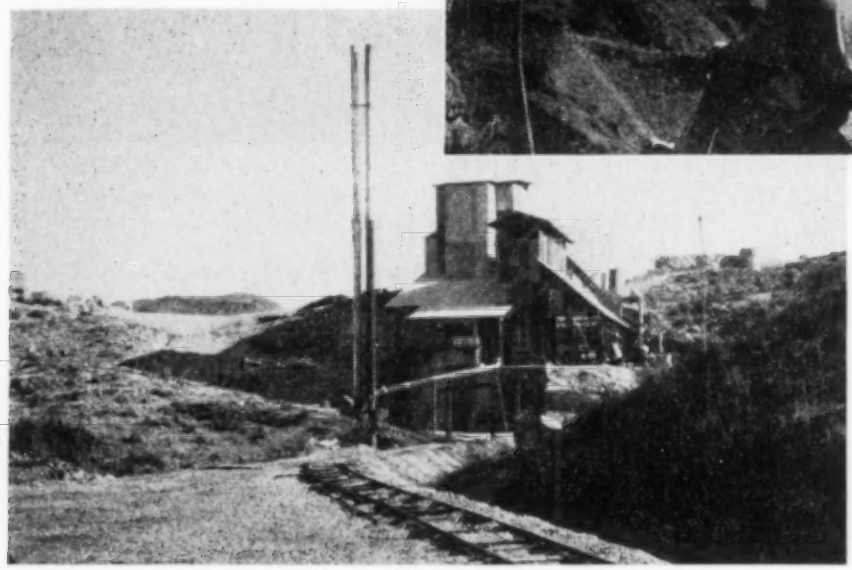


PLACING THE ANCHORAGE GEAR

The anchor, with its cable coiled within it, will be towed to the seadrome site and sunk by opening seacocks to admit water. Annular ring-type water brakes, made of manila rope and canvas, will control its rate of descent and make sure that it will reach the ocean floor right side up. The anchor will be flat on the bottom so as to give it a large contact area, and rounded on top to prevent fouling of the chain attached to it. It is expected that it will sink into the ooze of the sea bed and that the pressure of the overlying water will increase friction and hold the anchor securely against movement. It will be moored, as shown, to the spar-type buoy to which one end of the seadrome will be connected, thus always permitting it to swing freely with the wind. The anchor cable will be of the suspension-bridge type.

A New Mercury Mine in Texas

Winnie Smith



FURNACE PLANT AND NEARBY VIEW

The ore-treatment plant was revamped in 1942 and now contains a 30-ton Cottrell rotary furnace and appurtenant equipment. The property is in the Big Bend section of Texas, close to the Rio Grande and rugged terrain.

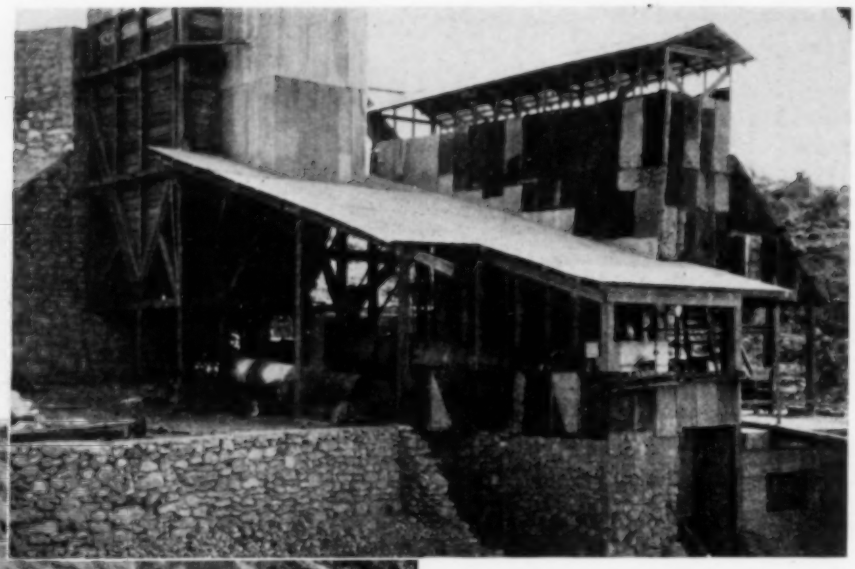
TEXAS has contributed mercury for domestic uses and war needs since early in the nineties. The ore has come from what is known as the Terlingua District, which is located in the Big Bend section of the state and adjoins the boundary of the newly established Big Bend National Park. The most recently developed producer, and the first of any real consequence in the region during the past 40 years, is the Fresno Mines, the discovery and opening up of which are due to the determination of Harris S. Smith, half owner and manager of the property.

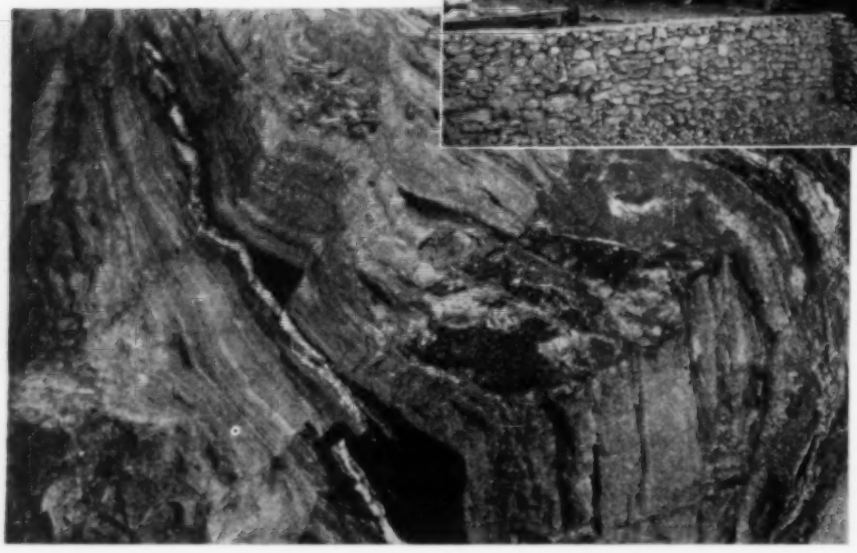
The odds were so great against a man in his late forties, that the story of his long struggle to keep the wolf from the door, the adverse conditions under which he had to labor, and the reaping of the final reward, sounds like a fairy tale come true. Soon after the end of the first World War, Mr. Smith, an ex-commissioned officer of the Officers' Training Camp at Leon Springs, Tex., exhibited a love for open country and pioneer life by establishing a ranch in the beautiful Chisos Mountains 90 miles south of Alpine, the nearest railroad town and shipping point. He wanted to have a hand in the development of the last frontier of Texas, and took the first herd of registered Hereford cows into the river country for breeding purposes. When he sold his holdings at a nice profit in 1929, his foresight and labor were duly rewarded. Choosing to continue in the ranching business, he promptly reinvested in the Fresno Canyon Ranch lying in a rough mountainous area in the southeast corner of Presidio County. The southern end of the property lay west of the then known mercury-producing region, and that is where the Fresno Mines and the new little town of Buena Suerte (Good Luck) are now located.

Like most men who are builders by nature, Mr. Smith wanted to expand. Consequently, he took a chance and increased the size of his ranch and the number of his livestock. And like many others who took a similar flier in 1929, he found himself during the depression carrying a heavy overhead, burdened with a big debt, and facing a long drought. He quickly realized that his life's earnings would be lost unless he found some other source of income. Interested in mining and geology, and being not far from the Chisos Mine whose operations he had observed for a number of years, he began a determined search for a cinnabar deposit on his own property. The cow hands and goatherders were given specimens of cinnabar, the ore from which most mercury is obtained, and they were instructed how to take samples. Then they were directed to the section of the ranch where there was every indication of the presence of ore. A reward was promised for any worth-while find.

Martin Bernal, a one-armed Mexican goatherder, soon proved to be the best prospector of the lot. One day in August of 1935, about two o'clock in the afternoon while watering his flock of Angora goats at a *tinaja* near his camp, a rainstorm came up suddenly and passed as quickly. Martin, soaked to the skin, headed for camp to see how it had withstood the storm and to change into dry clothes. When within a hundred yards of the place he glanced at the wet ground and at once realized that he was literally walking on cinnabar. The sun had come out bright and clear, causing millions of small particles of the mineral that lay scattered throughout a large area to shine and sparkle. He began an immediate search for the ore body, and the following day arrived at the ranch house with the good news of his find and a fair sample. Martin, in the course of time, received a satisfactory reward.

Although the discovery was made on Mr. Smith's property, the land was in a section of Texas in which the state retained the mineral rights, and it was therefore open to the public. To protect himself, it was necessary for him to file claims without delay, to engage a surveyor, and to do the initial assessment work. Moreover, a competent geologist





FURNACE CLOSE-UP AND CINNABAR

The rotary furnace, with the vertical condensers beyond it, is pictured at the right. Below is shown high-grade ore on the 60-foot level of the mine. The cinnabar is found in porous limestone, usually along faults or bedding planes.

would be needed to determine the extent of the mineralized acreage. All this required more cash than could be raised by one person heavily encumbered with debt.

Now it so happened that Mr. Smith had sold his ranch in the Chisos Mountains to H. M. Wilson, a graduate mining engineer and geologist of the Missouri School of Mines. Mr. Wilson had visited the Fresno Canyon Ranch on several occasions and on his way had passed an area, now known as the Contrabando Dome, that impressed him favorably as a potential source of cinnabar. When the two men became mutually interested in mercury mining, they formed a partnership that continues to this day. With the filing of the Fresno and other mining claims and the acquisition of the Contrabando Dome property there was begun an intensive prospecting campaign. Geologic maps were made, assessment work was undertaken, and sufficient mineral showings were uncovered to justify offering the holdings for lease or sale for mining purposes.

Increasing demands for minerals following the outbreak of the present war in Europe caused many geologists, mining engineers and scouts, along with some out-and-out promoters, to look over the Terlingua quicksilver district and to visit the Fresno prospects. Various lease and sale contracts, some by shrewd businessmen and others by unscrupulous persons, were submitted to Smith and Wilson; but none of them assured the partners a fair cash consideration, plus a royalty on future production.

In the meantime, ranching had gone from bad to worse. Low prices, severe droughts, and insistent bank demands were putting Mr. Smith out of business. Despite these conditions, he and Mr. Wilson, who was also hard pressed for cash, managed to do not only the required assessment work but also some valuable development work. In view of the continued rise in the price of mercury and the extent of the available low-grade ore, the partners decided to set up a homemade flotation plant to concentrate the cinnabar and to build retorts of well casing in which to treat the concentrates. June 1, 1939, saw the first continuous operation of the Fresno Mines, and at the end of a year of hard labor and almost unbearable expense, three flasks of mercury had been produced. The flotation process had proved a failure. The crude retorts were burned out; the rented rock crusher needed expensive repairs; the secondhand tractors and automobile engines that served as power units were worn to the point of uselessness. It looked as though the owners had reached the end of the trail, but they refused to give up.

It was then that $20,000 in cash was offered the partners for their property. Mr. Wilson, envisioning the apparently insurmountable obstacles that would have to be overcome to put it on a production basis, thought it would be wiser to sell than to try to operate with the limited means at their disposal. But Mr. Smith had faith in the mine and in his ability to make it a worth-while producer. He declined the offer. While the partners were pondering as to what course to pursue, they uncovered some good retort ore.

The superintendent of a neighboring mine, an old friend of Smith's, let him have a battery of four cast-iron retort tubes to be paid for at a later date either in cash or in ore. To make the installation and to meet some pressing accounts, including a payroll, Smith sold his last flock of Angora goats, the "tops" of some 4000 head he had owned. Although the animals were heavily mortgaged, he secured a little money with which to carry on. With this transaction, Smith felt that he had played his "hole card." If the hand did not win, it would be up to him to find a job.

It was then that Mr. Wilson was stricken with heart trouble and ordered to bed by his doctor. In consequence, the entire burden fell on Smith's shoulders, as Wilson was never again able to be an active partner. Fortunately, the ore continued to improve. Seven flasks of mercury were made in one month. More material was mined than could be retorted. In the community was stored a little 6-ton rotary furnace, and this was bought with a small down payment and on liberal terms for the balance. With no blueprints as guides, but with determination, a prodigious amount of hard work, and much trouble in procuring re-

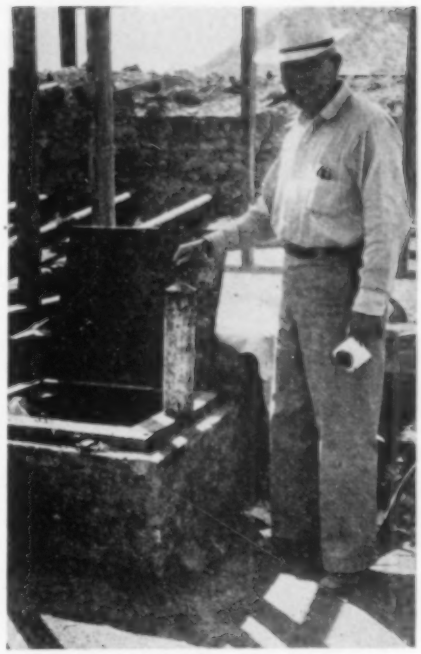
pair parts, the furnace was set up and put in running order. By the spring of 1941 it was turning out a flask of quicksilver a day.

As soon as some pressing debts were liquidated, Mr. Smith began junking his secondhand equipment not so much because he was tired of patching it up for another round but because he realized that shutdowns make for high production costs. Further, he felt it to be his patriotic duty to supply as much mercury as possible to help meet the Government's demand. Permission was obtained from the War Production Board to set up a 30-ton Cottrell rotary furnace, and this was ready for service on July 4, 1942. The mine was equipped with Ingersoll-Rand Jackhamers, stopers, drifters, and a 315-cfm. air compressor. Installation of a double-drum air hoist to operate a slushing scraper saved time and labor. The stationary power units, as well as the mercury furnace, are fueled with butane gas which, burning free of soot, simplifies cleaning up. Facilities for storing 10,000 gallons of butane have been provided, and the gas is made available to those camp employees who have use for it in their homes. Living quarters with water and electric lights are furnished the American workers, and there are ten well-built houses of native rock for the Mexicans. The schoolhouse and general store also are of stone.

When Federal funds were being allocated for the construction of access roads to mines producing strategic metals, Mr. Smith made application and was awarded the contract for 17 miles of road connecting the mining camp and State Highway 221. Shortly after the completion of the project, a U. S. Post Office was opened at the mining camp, giving it the official name Buena Suerte. This took place on May 21, 1943, and the little town now has a population of well over 200.

At Fresno Mines, as is the case with most mercury producers, the predominant ore is cinnabar. The ore is found in a porous limestone at the contact of the upper and lower Cretaceous. By reason of dips in the formation, mining which began in an open cut has now proceeded to a depth of 100 feet. The deposits occur along the faults and bedding planes and, in highly fractured areas, in pockets that vary in size and usually supply the richest ore. Skill is required to extract the mineral, for the faces are often too hard for pick work and yet too soft for satisfactory drilling operations.

As reported by men who have had a chance recently to see most of the quicksilver mines in the United States, one of the most spectacular ore pockets ever uncovered was that encountered in the Fresno Mines during the fall of 1942. It was approximately 3 feet thick, 20 feet wide, and 30 feet long, and yielded more than a flask of metal per ton. But such ore bodies are rare and, like this one, do not extend for any great distance. The geological structure and cinnabar showings, however, give promise that profitable production will continue at Fresno Mines for some time to come. The partners, Smith and Wilson, have been well rewarded for their hard work and perseverance. Mr. Smith has accomplished what he set out to do—to develop a mine on his ranch, and the income therefrom has exceeded his expectation.

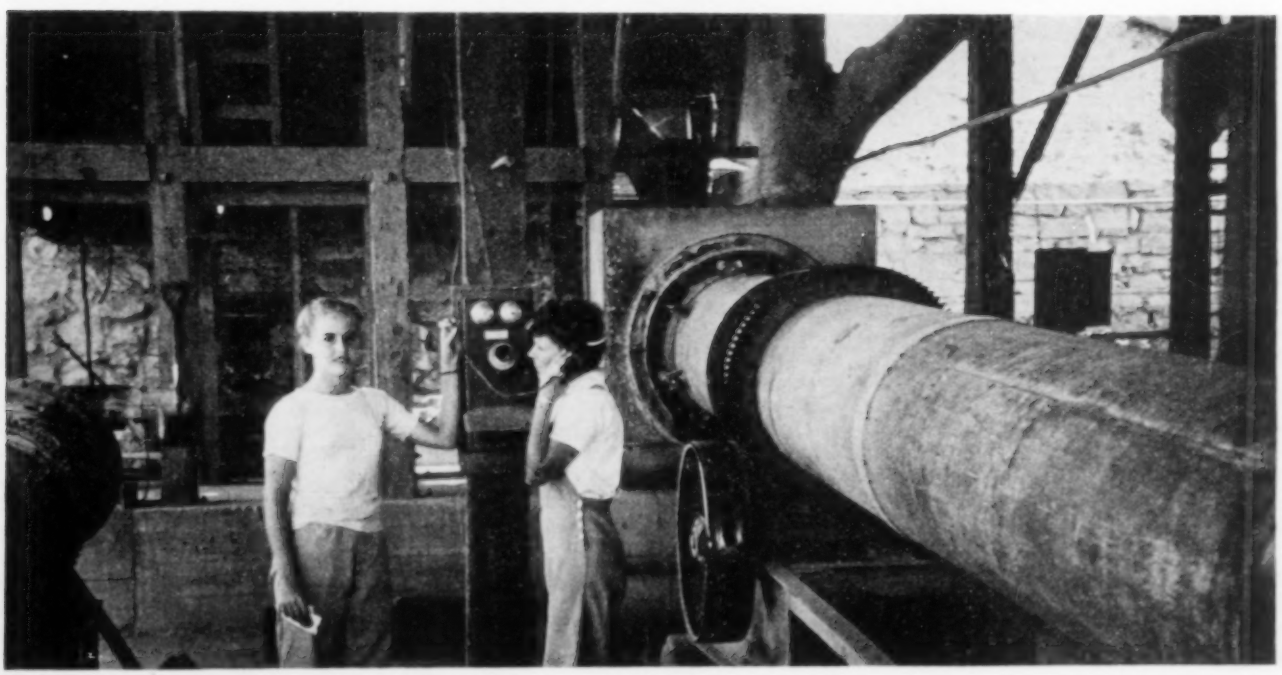


HARRIS S. SMITH

Manager and half owner of Fresno Mines shown with a flask of mercury at the clean-up pot of an old furnace during an early stage in the operations.

THE GIRLS DO THEIR PART

Willeen and Celia Smith, daughters of the manager, fill jobs in the plant to help relieve the labor shortage. At the right is a section of the 30-ton Cottrell furnace that was put in service on July 4, 1942.



New Mexico Tourist Bureau

Road to Empire—the Santa Fe Trail

John L. Sinclair

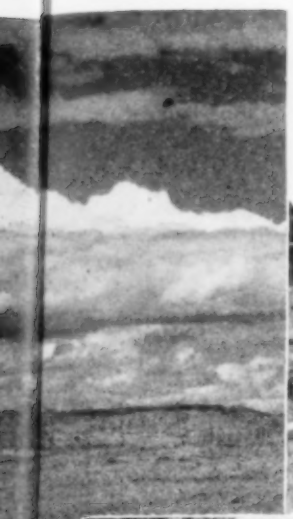
JUST off the main highway about midway between Glorieta and Santa Fe, N. Mex., there is a piñon-covered hill. It is similar to a hundred others dotted about that foothill country—an insignificant little blister compared to the bulk of the Sangre de Cristo range raising its 12,000-foot peaks only a dozen miles to the north. On the side of this hill, in years gone by, hoofs and wheels carved a monument to a great thoroughfare—a path to empire.

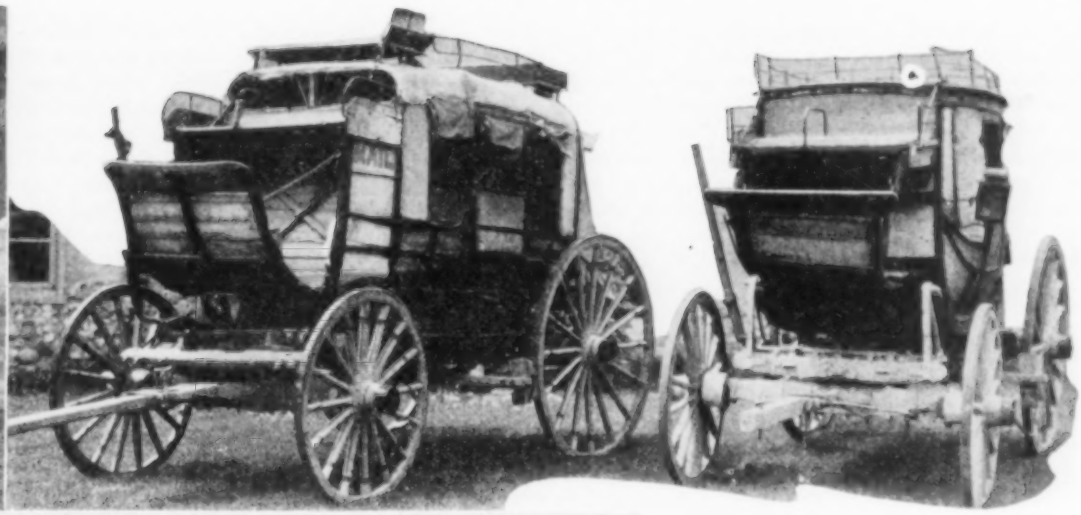
Climbing steadily from foot to summit is a washed-out road overgrown with weeds, trenched with ruts, covered with boulders. Even as a horseback trail it is bumpy going. But this rough swath was once a bend in the great trade route from the Missouri Valley to the Rockies—the Santa Fe Trail—a highway that is sung about, on which books have been written, and to which monuments have been erected, because great trails, just like great men, are made much of after they have gone to dust.

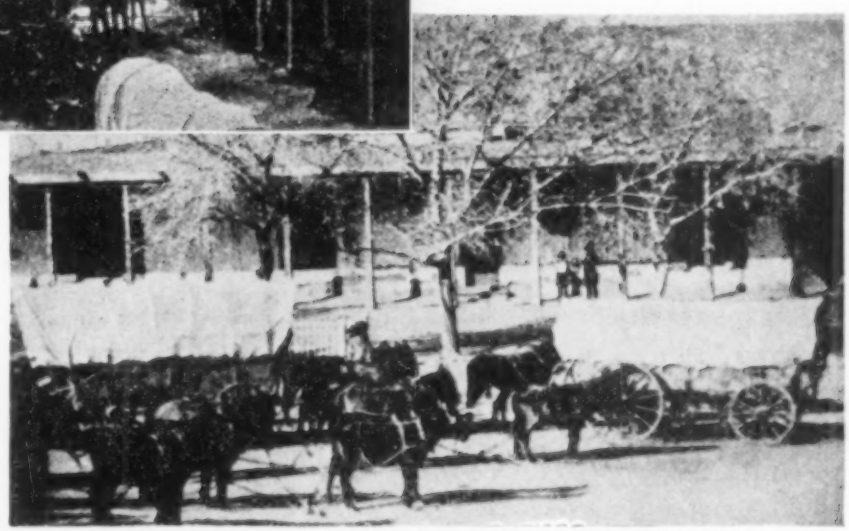
Freighters from the East urged their weary oxen on with joy at this stage of the journey in the knowledge that they would reach their long-hoped-for destination before the sun set again. There, stage drivers cracked their whips and whistled to their teams, for from this point it is but 13 miles to Santa Fe Plaza. From the hilltop, today, can be seen the new highway—broad, oiled, straight—built for a faster but frailer generation.

It is said that in the year 1774 there arrived in St. Louis, Mo., from the West an American, named John Peyton, who had been captured by the Spaniards on the Texas gulf coast and whose person exhibited the effects of a year spent in a dungeon in Santa Fe, the capital of Mexico's frontier province of New Mexico. Naturally, Peyton was in no mood to boost the trade possibilities of the adobe city after his harsh treatment there, but he gave Missouri folks an idea of conditions at the southern end of the Rockies. He let them know that the Spaniards had no desire to do business with any foreigners. It was their belief that the Frenchmen of Illinois, some of whom had come south to trap beaver and to give the Indians firearms in exchange for furs, had aided the Pawnees in massacring one of their officials, Pedro de Villazur, and his party while on an expedition into Kansas. Santa Fe was therefore ready to wreak vengeance on anyone not Spanish, and did so.

Two Frenchmen, by way of example, came to Santa Fe with a load of merchandise in 1752 and were met with apparent gladness by the law-abiding citizens. The populace, eager to obey their viceroy's orders, confiscated the oxen, carts, and goods of the trespassers on Spanish territory, while the unhappy victims were sent off to Mexico City in chains. To celebrate the fate of the







Historical Society of New Mexico

ALONG THE OLD TRAIL

The ruts of the old road are still visible in the prairie grass where the route passes the ruins of Fort Union (opposite page). At the left is shown a wagon train soon after its arrival at Santa Fe Plaza. Note that most of the oxen are lying down for a well-earned rest. Two historic stagecoaches that once traveled the trail are pictured above. The one on the left is the Barlow-Sanderson coach that was held up on Raton Pass in 1867 and robbed of $60,000, the other is the famous Concord coach. Covered wagons and the horses that drew them are pictured below on Santa Fe Plaza

Frenchmen the Santa Feans danced a fandango.

A few years after that event a change came over North America as a result of the Seven Years' War started by Maria Theresa and Frederick the Great. That upheaval in Europe affected English, French, and Spanish alike on this side of the Atlantic, and by 1763 new flags were flying over Canada and the Louisiana territory. By 1822 not only the English colonies south of the St. Lawrence River were free of the European yoke but also Mexico; and as Santa Fe was part of a great new nation, with a red, white, and green flag of its own, the fiesta-loving people again danced the fandango on the plaza. That year the ban on trade from the North was lifted, and so began the Santa Fe Trail.

Sixteen years prior to Mexico's independence, President Jefferson sent Lieut. Zebulon M. Pike to explore the country to the west and at the same time try to establish friendly trade relations with the Spaniards. The lieutenant's expedition to New Mexico resulted in the finding of the peak in the Colorado Rockies that bears his name; in the knowledge that Americans would be met cordially by the Mexicans if they approached them properly; and in a report on the region beyond the prairies.

"New Mexico," Pike wrote to his chief in 1807, "carries on a trade with Mexico through Biscay (Chihuahua), also with Sonora and Sinaloa; it sends out about 30,000 sheep annually, tobacco, dressed deer and cabrie skins, some fur, buffalo robes, salt, and wrought copper vessels of superior quality. It receives in return from Biscay and Mexico, dry goods, confectionery, arms, iron, steel, ammunition, and some choice European wines and liquors; and from Sonora and Sinaloa gold, silver, and cheese."

Two years before Pike's visit to Santa Fe, a French trader, Baptiste Le Lande, pulled into town with a load of goods, to be followed soon after by James Purcell of Kentucky. Both successfully sold their cargoes and escaped durance vile by remaining in the community to become residents. Not so the adventurous

Robert McKnight, who managed to keep his scalp while crossing the Indian-infested prairies in 1812 only to get nine years in the Chihuahua calaboose for his pains. David Meriwether of the American Fur Company was hauled up for a stretch in 1819, but was soon pardoned and made tracks for home. This same Meriwether returned to New Mexico in 1853 to become a territorial governor for the United States and occupied the Palace of the Governors in Santa Fe, the building in which he had been imprisoned 34 years before.

By 1822 the Mexicans of New Mexico were ready to call the Americans of Missouri *muy buen amigos*, paid no more allegiance to the gartered-and-frilled King of Spain, and gave his viceroy the bum's rush. Then traders from the East whacked their oxen westward, their carts and wagons loaded with products of St. Louis, New York, and even Europe. Santa Fe was no longer a mere outpost on Mexico's northern frontier, but a junction with trade routes branching westward and southward—the long trail across Arizona to the Pacific, and the Chihuahua Trail to Mexico by way of the Paso del Norte.

In 1821, when Mexico was scrapping with Spain for her independence, Capt. William Becknell arrived in New Mexico with a cargo and returned to Missouri with good health and profits from his venture. On a second trip the following year he blazed the Santa Fe Trail across Kansas, into Colorado, south to New Mexico, and around the southern point of the Sangre de Cristo Range, halting his wagons in Santa Fe Plaza. Independence, Mo., a short distance east of Kansas City, was the eastern terminus. Trade was brisk, once the "commerce of the prairies" was established, and continued so for 58 years. During that span of time drygoods, foodstuffs, hardware, all piled in freight wagons, rolled westward, some to reach their destinations and others to fall to hostile Indians and bad men. Back to Missouri went loads of silver bullion, gold, buffalo robes, furs, hides, Indian blankets, and wool.

The trail was such a vital line of communication that forts were built *en route* as a protection for those who used it. Forts Zarah, Larned, Dodge, Aubry, Bent's Fort, and Union stood alongside the rutted way. Upon the sites of some of these later arose important towns such as Dodge City, Kans., and La Junta, Colo. During the heyday of 1850-80 places with picturesque names—Council Grove, Diamond Springs, Plumb Buttes, Cimarron Crossing, Choteau's Island, Hide in Rocks, and Hole in the Prairie—were stops for freighters and stage drivers. Leaving the Missouri River where Kansas City now stands, the Santa Fe Trail crossed the prairie until it struck the great bend of the Arkansas in mid-Kansas and followed the valley to Bent's Fort between Las Animas and La Junta. Then taking a course southward it went over the Raton Pass into New Mexico and reached Santa Fe by way of Fort Union, Las Vegas, Glorieta, and Canoncito Gap, covering an over-all distance of some 780 miles.

After the close of the Mexican War in 1846, when New Mexico became a territory of the United States, commerce on the trail boomed. Merchants established firms in Santa Fe and built warehouses to receive merchandise from "The States" as well as trains of products that came in from Mexico over the Chihuahua Trail. Most famous of these traders were the Spiegelbergs and Seligmans. Solomon Spiegelberg established the firm of Spiegelberg Brothers in 1846. Their story is a book in itself; they were master merchants and frontier traders. Goods handled by them found a home in the eastern states, in Arizona, California, Mexico, and Europe, and in every remote *pueblo* and *placita* in New Mexico. An advertisement in the *Santa Fe New Mexican* of July 9, 1868, when traffic on the trail was at its peak, read as follows:

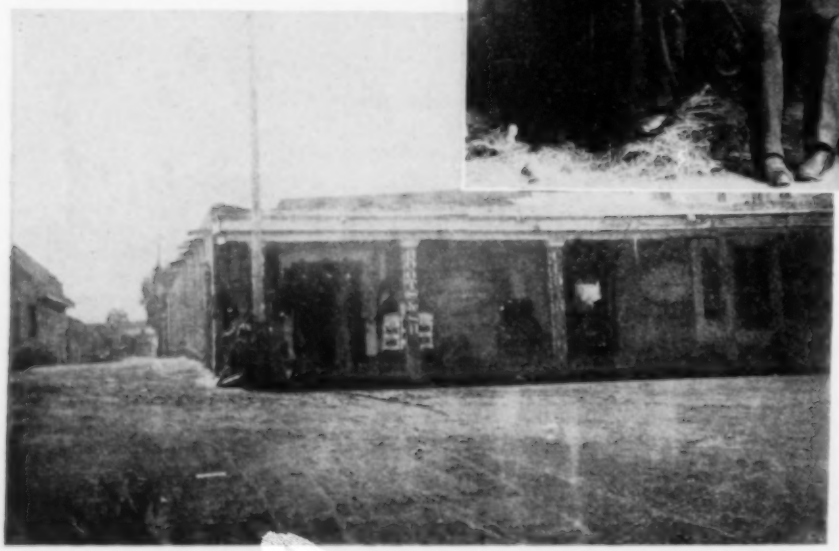
"Spiegelberg Brothers—Importers, Wholesale and Retail Dealers in Foreign and Domestic Dry Goods—Clothing, Boots, Shoes, Hardware, Queensware, Liquors, Groceries, Etc., Etc.

"Merchants will find it to their advantage to see us before going East, as we keep on hand an assortment of goods especially

PIONEER MERCHANT PRINCES

The Spiegelbergs and the Seligmans were the leading traders along the Santa Fe Trail long before the turn of the century. The five Spiegelberg Brothers pictured below are, from left to right: Willi, Emanuel, Solomon, Levi, and Lehman. The Seligman trading post, established in 1856, is shown at the bottom.

Historical Society of New Mexico



Historical Society of New Mexico

THE TRAIL TODAY

Broad, paved, and without heavy grades, the present Santa Fe Trail was built for a faster but frailer generation. Modern roadbuilding equipment such as the wagon drill shown has helped make it so. The sinuous route of stagecoach days had a length of 780 miles.

adapted to this market and to adjoining territories."

Wagon trains from the East pulled up before Spiegelberg's warehouse at steady intervals. An item in the paper on July 29, 1868, marveled at the speed of commerce on the Santa Fe Trail:

"The Messrs. Spiegelberg Bros. received a train on Monday 27th loaded with goods shipped from New York only forty days ago. This, we understand, is the quickest time ever made."

The Spiegelbergs did not rely solely on trade over their counter in Santa Fe, but braved all the dangers—Indians, bandits, and such—of the frontier in order to peddle their wares. A circus came to town one summer and left behind a gilded wagon, its panels inlaid with mirrors. The firm purchased the gaudy conveyance and turned it over to Abraham Spiegelberg for some high-pressure selling. Abe loaded it up with drygoods, clothing, hats, bacon, ham, jewelry, watches, shoes, rifles, pistols, powder, cartridges, and tobacco. He set out for the remote settlements, where the bright New Mexican sun caused his wagon to glisten like a diamond for miles distant, much to the villagers' awe and Abe's profit.

No less important was the Seligman firm at the end of the trail. Sigmund Seligman founded a trading business in Santa Fe in 1856. He accepted a partner, Charles Cleaver, and the establishment took the name of Seligman & Cleaver. The firm was subsequently joined by the former's nephew, Arthur Seligman, who was to become a governor of New Mexico in this century. The Seligmans later financed the building of the branch of The Denver & Rio Grande Western Railroad extending from Antonito, Colo., to Santa Fe. Some idea of the extent of their business can be had from the fact that in the course of one day in Kansas City they loaded a train of 83 wagons, carrying 5000 pounds each, with goods for their Santa Fe store. The merchandise was valued at $125,000, the freight bill paid was $30,000, and the calculated profits $51,000. They sold the cargo out in three weeks.

The Santa Fe Trail was created a post route by Act of March 3, 1847. Emigrants and freighters accompanied the mail carriers for protection. On July 1, 1850, the first monthly stagecoach service between Independence and Santa Fe was inaugurated. It took two weeks to make the trip, longer if a fight with Indians delayed the journey. The fare was $250, with an allowance of 40 pounds for baggage and a charge of half a dollar a pound for excess. Today, the trip by Greyhound bus costs only $15.40, and is covered in 36 hours, with a guaranty of not a hostile Indian along the way. In 1880 the tracks of the Atchison, Topeka & Santa Fe Railway reached the trail's end, and traffic to and from the East followed the same route as the lumbering freight wagons but with much more speed and comfort and at less expense.

Modern roadbuilding machinery has played a major part in making the Santa Fe Trail the fine motor highway that it is today. Along its course, hillsides have been cut away to avoid steep grades and sharp curves, *arroyos* have been embanked and culverted. The high passes of the Rockies are no longer formidable. Massive concrete bridges stride the creeks through which the early-day stagecoach and freight wagon forded. Maintenance crews are continually on the job keeping up the reputation set by the pioneers of 1822 for the trail as a road to empire.

The straightened and paved trail now carries thousands of travelers in de luxe buses that were accompanied, before gasoline rationing, by numerous family cars, while heavy diesel trucks transport countless tons of merchandise from the East to the great markets of the West. The famous old road, as fine an automobile highway as the Southwest has to offer, still comes down from the Missouri, follows the Arkansas, and climbs over Raton Pass to Santa Fe, which is and always will be "The End of the Trail."

Tantalum—the Mineral of the Hour

TANTALUM, a metal most people have never seen, is so important in the war effort that some 8000 Brazilians are engaged in searching for and extracting its ore, tantalite, at 400 locations scattered over 3600 square miles of territory in the states of Paraiba and Rio Grande do Norte. It has the top aerial-transport priority rating of all strategic materials, and the entire Brazilian production is flown to the United States as soon as it can be put aboard planes.

Tantalite is an oxide of tantalum and iron, with some manganese frequently present. In addition, it almost always contains columbite, a metal closely related to tantalum; and sometimes the columbite predominates. Pure tantalite, which exists only in theory, contains 86.1 percent tantalum pentoxide, or about 70 percent tantalum. The Brazilian ore averages 45 percent in the pentoxide, but tantalite is so widely disseminated in the earth's crust that some 3000 tons of rock must be handled to obtain a ton. Until recently, the whole output was produced by manual methods. These still predominate, although American-made air compressors, rock drills, and other mechanical aids are being made available as fast as possible by the U. S. Purchasing Commission, which buys all the Brazilian tantalite.

Tantalum itself is a lustrous white metal, but its ore is coal black and, in view of its current importance, is sometimes called "black gold." At one time the filaments of electric-light globes were made of tantalum, but it was superseded by tungsten and thereafter was of comparatively little commercial importance until recent years. The metal is as hard as soft steel but has much greater tensile strength and can be hammered into very thin sheets and drawn into extremely fine wires. As it is highly resistant to corrosion, it is coming into widespread use among surgeons for repairing bones, especially those of the skull, and for joining nerves that have been severed. Tantalum carbide has a hardness approaching that of the diamond and is consequently in demand, either alone or in combination with carbides of tungsten and titanium, for metal-cutting tools. These carbides are also employed in making wire-drawing dies and the wearing parts of machines.

According to the *Minerals Yearbook*, published by the U. S. Bureau of Mines, tantalum is used in considerable quantities for the manufacture of corrosion-resistant apparatus and equipment for chemical plants and laboratories. Copper or steel pipes can be covered or lined with a thin layer of tantalum. Either in such combinations or by itself tantalum serves in various types of heat exchangers, pump and valve parts, nozzles, and spinnerets for rayon and other synthetic fibers or threads, in temperature-control apparatus, as well as in sundry vessels and parts exposed to chlorine or other corrosive agents. Being more resistant to acids than platinum, tantalum is valuable for making chemical-laboratory ware that does not have to be heated. When hot, the metal has a marked affinity for oxygen and carbon and will combine with them. When immersed in acid, tantalum permits an electric current to flow only one way, and this property has rendered it useful in certain electrical cells and in rectifiers. Owing to its gas-absorptive properties it is one of the best metals for radio transmitting tubes and enters into portable sets supplied the armed forces.

A BRAZILIAN TANTALITE MINE

Here the mineral is found in a pegmatite dike which is being excavated to recover it. Tantalite is difficult to locate and exploit because it can be easily confused with other minerals.

Numerous alloys of tantalum and other metals have been produced. Some of these are used for surgical and dental instruments, and one tantalum-steel alloy is a suitable material for springs, saws, and gun barrels. Another, known commercially as tantaloy, is so hard that it cannot be machined and is supplied in the form of bars, rods, and other simple shapes for welding base metals. Sintered tantalum is valuable for making electrolytic condensers. It has a coarse, porous structure whose many microscopic surfaces are covered with tantalum oxide that gives it its condenser qualities.

Most of the world's supply of tantalite formerly came from the Pilbara field in Western Australia. Some was produced in Nigeria, in the Belgian Congo, and in South Africa. All these sources are still contributing, but the office of the Co-ordinator of Inter-American Affairs states that 52 percent of the annual output is now coming from Brazil. In the latter country tantalite is found in association with other minerals in pegmatite dikes and also in alluvial deposits. Prospecting for it is likened to searching for the proverbial needle in a haystack, and once it is located, there ensues a problem of determining whether there is enough of it to warrant a large-scale mining development. A likely looking lode frequently yields a few pounds of high-grade ore, then peters out. An obscure deposit, on the other hand, may suddenly turn into a rich and plentiful source of supply. Always, however, it is apparent that tantalite is well named, for it is tantalizing to those in quest of it because it is difficult to distinguish from other minerals with similar characteristics. At best the search is a touch-

and-go business with Dame Nature leading the prospectors a merry chase.

The interior of Brazil where this mining drama is being staged is a bleak expanse closely resembling North America's semiarid Southwest. The torrid sun beats down on a rainless, thin-grassed country of granite-faced mountains and occasional spiny cactus plants. Slowly but surely man is winning the battle, for tantalite production in 1943 was up 140 percent over 1942 and this year's output is expected to be double that of the previous twelve months.

The 400 properties being operated are all run by private individuals or companies that sell their tantalite to exporters, who, in turn, sell the bagged, graded mineral to the U. S. Government. Uncle Sam's role is that of grubstaker and technical assistant. By agreement with the Brazilian Government, the U. S. Purchasing Commission, headed by Leo Crowley, not only buys the mineral but also lends money to the producers to stimulate development of the mines. For its part, the Brazilian Government has assigned technicians to work with the American engineers in speeding up exploitation. In 1940, before the current rush for tantalite began, Brazil's National Department of Mineral Production built a laboratory at Campina Grande to analyze and grade the ore. This laboratory has rendered invaluable assistance in locating high-grade tantalite.

Our Japanese and German foes are keenly aware of the many strategic uses of tantalum, and until two years ago their agents were on the ground busily engaged in buying all the Brazilian ore they could get. Fortunately for the Allies, Brazil's tantalite output was very low during that period. Only a negligible amount of the mineral fell into enemy hands, and after the Pearl Harbor attack Brazil slammed the door on further Axis purchases.

Tantalite mining is an expensive proposition. While labor is fantastically cheap (most unskilled workers earn around 30 cents a day), the average producer finds it hard to make ends meet owing to the small quantity of tantalite which he is likely to get after extremely laborious effort. As a consequence, operators are turning increasingly to the simpler and far more profitable scheelite mining, and the USPC is hard-pressed to check this trend. Many Brazilians feel that the tantalite business is a war bubble that will soon burst, and they don't want to be caught short. But the USPC men have effectively counteracted this belief by easing the mine owners' financial burden through loans and higher prices and by pointing out the fabulous peacetime future which tantalite appears to have in the field of electronics.

The USPC's tantalite program didn't get into full swing until February, 1943, after a preliminary geological survey in the summer of 1942 had shown the wisdom of a large-scale mining effort. Brazil's ore was found to exceed by far in quality and to more than equal in quantity that obtained in Australia and South Africa. Some prospectors have been pecking away at tantalite mining since 1927, and the industry materialized in 1937; but it took the war and the pressing military need for the mineral to set this area booming.

Transportation to the tantalite mines, sprawling over vast distances, has been a huge problem. The old sandy roads twisting over mountains and across valleys were inadequate and had to be improved before they could handle truck traffic. The USPC alone added about 65 miles of new country-type roadway, and is building more. And it is interesting to watch the curious expressions on the faces of the Brazilian rural folk, many of whom are seeing their first "jeeps" bouncing along.

Mechanization of tantalite properties has been slow. Machines are something brand-new to these Brazilian miners, who have traditionally worked with the most primitive tools, and it naturally takes them some time to learn how to operate them. But as compressors and Jackhamers and other equipment gradually arrive from the United States, the Brazilians are gaining valuable experience that will stand them in good stead after the war. U. S. Government agencies are sending down about $250,000 worth of mining and milling machinery, including large crushers and rolls, that is being leased to the producers at low cost. Before the present up-surge in mining activity, the Brazilians had never used such expensive equipment because they couldn't afford it.

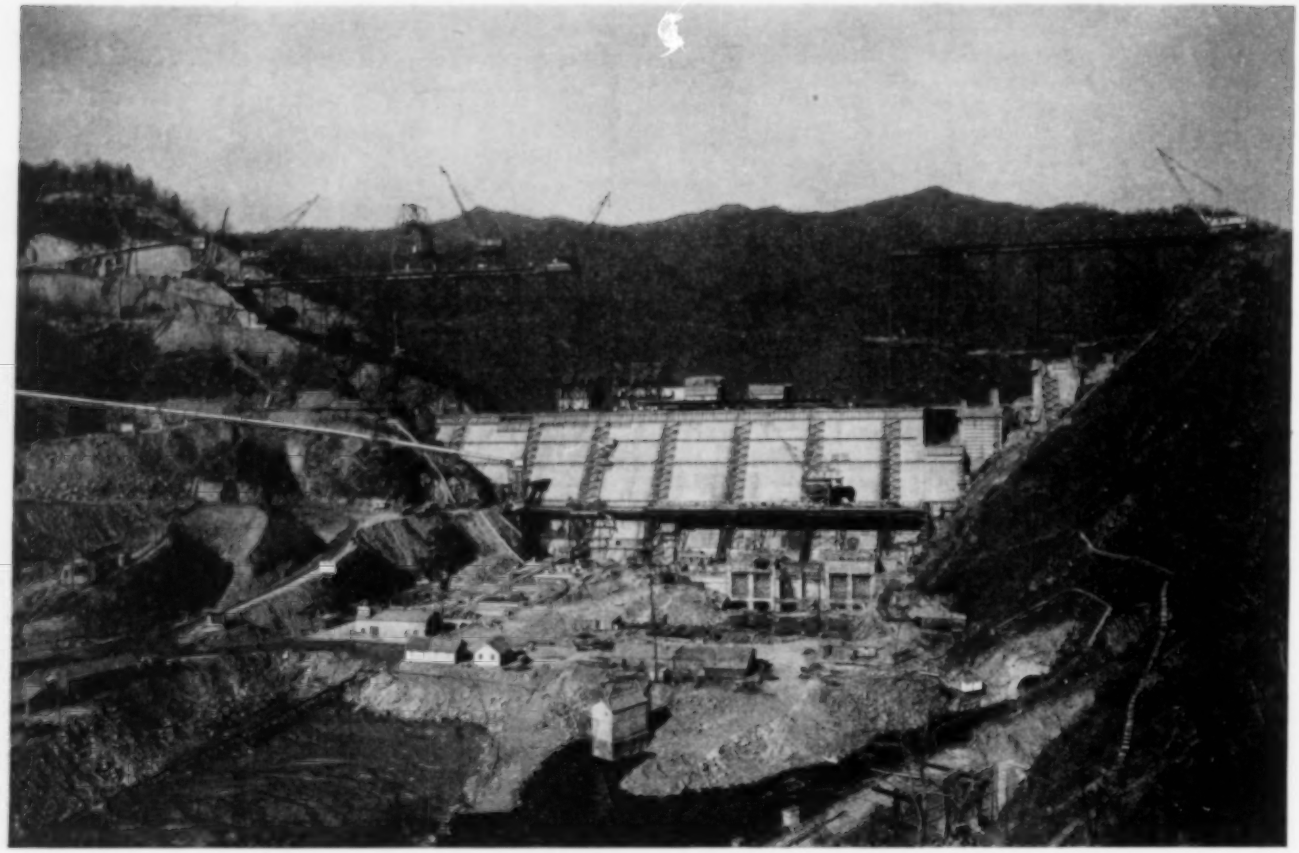
Today, the mining men generally are still resorting to old-fashioned hand washing to recover tantalite. They set up wooden sluice boxes near subsurface deposits and dig holes to hold water, which is usually carried in gasoline cans by long-eared burros from streams sometimes miles away. The rock and dirt are broken, screened, and then washed in the water box. Tantalite, being heavy, sinks to the bottom while the dirt drains off. The precious overflow water is then collected and used again.

The miners live near their work, far from the comforts of even the small interior towns. Most of them have thrown up thatch-roofed lean-tos next to their excavations, sleeping ten or more men in hammocks strung diagonally across the interior. Outside one is almost certain to see big steaming pots of *feijao*, the rice-and-bean dish of Brazil. Life is dull because there is little to do to break the monotony.

Once or twice a week the miners gather together their tantalite ore, pack it on burro-back, and set off for the nearest town, where dealers weigh the mineral, judge its quality. These, in turn, ship the ore by truck to Campina Grande where it is graded, washed, sun-dried and bagged. It is then ready to start its air journey to the United States.

METHODS OF RECOVERY

At the left is a desert mine, with sluice boxes set up to wash the tantalite. Water is hauled in cans on burroback and is used over and over to conserve it. Above is a close view of some tantalite, the product of many washings.



FONTANA DAM

This structure is on the Little Tennessee about 60 miles above its confluence with the Tennessee River and will form a reservoir with a usable storage capacity of 1,200,000 acre-feet. It is strategically located for integrated operation with five existing developments on the Little Tennessee watershed and will increase power production by 2,000,000,000 kw-hrs. during a year of average stream flow. The turbine installation will consist of three units rated at 91,500 hp. when each is operating under a head of 330 feet and at 150 rpm. Only two of the generators are to be installed at the outset. The dam is in North Carolina and will be the highest structure of its kind east of the Rocky Mountains.

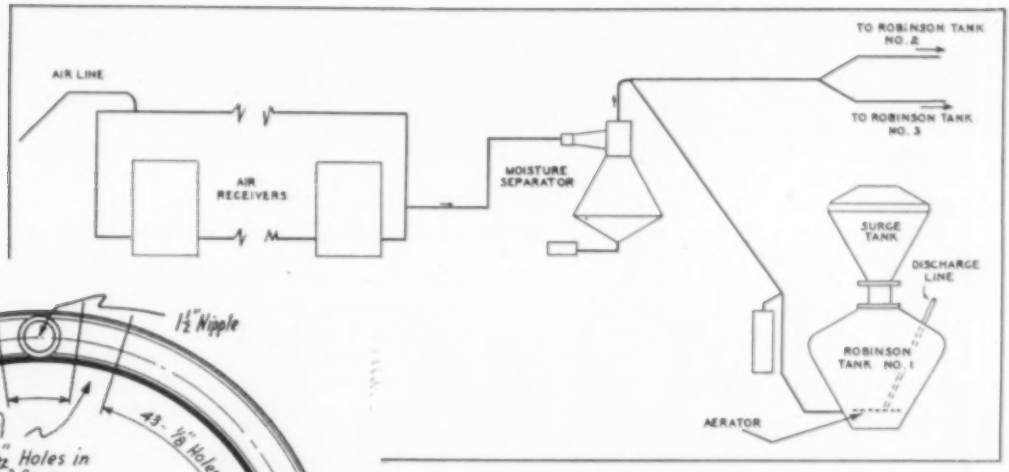
Compressed Air on the Job at Fontana Dam

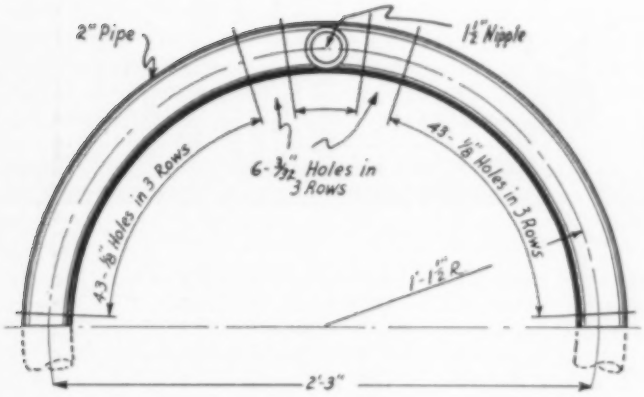
A. M. Hoffmann

RACE against time to complete Fontana Dam, one of the TVA projects, probably accounts for some of the methods and equipment used there by the contractor to speed up operations. The dam was authorized by Congress in January, 1942, as a war-emergency measure, and is scheduled for completion early this year. It will have a crest length of 1750 feet, including the spillway and auxiliary structures, and will be 470 feet from top to bottom, making it the highest dam east of the Rockies. Some 2,800,000 cubic yards of concrete will enter into its construction and will involve the handling of large quantities of cement. The system installed for this purpose differs considerably from the type generally utilized on projects of this magnitude and requires thousands of cubic feet of air per minute to transport the cement from railhead to the concrete mixing plant.

The cement is delivered in bulk in standard box cars and is transferred by power scrapers into hoppers surmounting three unloading pits, all placed adjacent to paralleling tracks so that six cars can be unloaded at a time. Each pit is served by a chain-flight conveyor that travels at a speed of 28 feet per minute and carries the material from the hopper to a 50-barrel surge tank about 25 feet distant. From there it passes by gravity to a Robinson air-activated conveyor tank which, when full, is charged with compressed air through the medium of numerous small jets. The air serves not only to aerate the cement but also to build up pressure inside the tank, thus causing the material to flow like a liquid through a 6-inch discharge line an average distance of 2966 feet to a silo. Inside the tank is an air-ram-operated gate that both opens it to receive cement and seals it to prevent the escape of compressed air during the aeration and discharge period.

There are four silos, one adjacent to the mixing plant and a group of three 150 feet away. Each has a capacity of 6000 barrels. Only three of these are filled in the manner described. The fourth—the center one of the group of three—serves as a collector and vent for the two flanking silos, catching their overflow when they are full. Three additional conveyor tanks are provided for transferring the cement from the four silos to the mixing plant. Those at rail-





CEMENT CONVEYED BY COMPRESSED AIR

The upper drawing shows the set-up of part of the cement conveying system at railhead. At this point there are three combination surge and Robinson tanks from which the material is blown through 6-inch lines to silos. The maximum distance of travel is 3000 feet, including a 290-foot rise. Details of the aerator in the bottom of the Robinson tank are at the left.

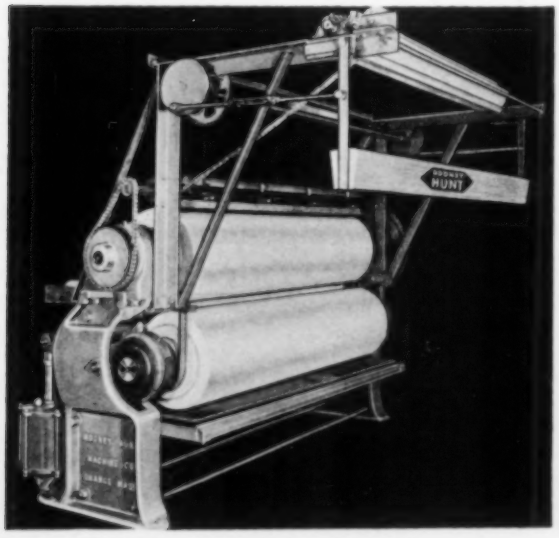
head require approximately 533 cubic feet of free air per barrel of cement handled, while those serving the silos, with the shorter distance of travel, use a little less. It is worth noting that in its passage through the several lines, the material is lifted a minimum of 90 feet and a maximum of 290 feet.

The concrete for the dam and appurtenant structures reaches the various points of application in 4-cubic-yard, air-operated, bottom-dump buckets that were designed and built by the Authority. They are shuttled out by train and picked up and swung into the forms by hammer-head and revolving gantry cranes. The conventional method of opening the buckets involves the use of a manually operated lever or wheel. This sometimes refuses to budge, and then the worker strikes it with a sledge or similar tool. Further, it is necessary for the operator to ride the bucket during dumping, and this is hazardous. It takes on an average fifteen seconds to empty a bucket of this type. Failure of the gate to open promptly may seem to be a trifling matter in itself, but when 700,000 bucketloads have to be handled, as is the case at Fontana, the aggregate time loss may be appreciable.

On the Fontana job, concrete placing goes on with less interruption chargeable to buckets. As soon as one is positioned, a worker inserts the nozzle of an air line into one of two small sockets at its base, turns on a quick-acting air valve, and the gate drops, together with the load, all in less than two seconds. It is estimated that from two to three weeks of pouring time will be saved as a result of this innovation.

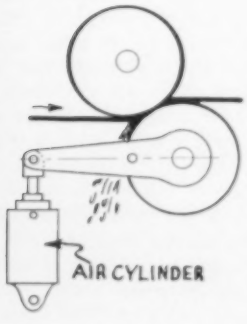
Improved Moisture Extractor for Textiles

WHAT is claimed to be the heaviest-duty squeeze roll extractor for textile mills has been announced by the Rodney Hunt Machine Company. The machine is designed for the continuous, high-speed extraction of moisture from open-width knitted, woven, or piled fabrics and for a variation in roll pressure ranging from zero to 30,000 pounds. The rolls have a diameter of 18 inches and are made of cast iron covered with rubber of a specific density.



WRINGER

The improved motor-driven machine with cloth folder attached. The disposition of the rolls and the means by which pressure is applied to the lower one are shown in the drawing.



The distinguishing features of the unit are two in number. Instead of a movable top roll it has a movable bottom roll that drops by gravity. The advantage of this is that there is no need of maintaining pressure to keep the rolls out of contact when the machine is idle. Secondly, the rolls are "cocked," set at an angle in relation to each other, so that the cloth is inclined as it passes between them. This arrangement has solved the problem of wet selvages caused by liquid that remains along the edges of rolls set one above the other. Roll pressure is exerted by compressed air, and in order to equalize it the air is piped to the middle of the extractor and thence to each side to a pneumatic cylinder. Air can be either taken from a mill's main line or supplied by means of a small motor-driven compressor. Squeeze rolls of this type are handling textiles at a maximum rate of 55 yards a minute.

Touring Power Plants

JUST three years ago we commented here on the development of floating power plants that could be moved on coastal and inland waterways to supplement generating facilities on land or to render emergency service in areas where the production of war goods is concentrated. Now the electrical engineers have put similar, although smaller, central stations on railroad wheels.

One type of these new "roving powerhouses" has been used by the Navy's Bureau of Yards and Docks. According to the manufacturer, each plant consists of a 3-car unit comprising a complete 10,000-kw. steam-electric generating station and can supply power quickly for any of the bureau's many projects. Probably as a result of the successful application of this mobile equipment at home, another company is building ten 5,000-kw. car-borne generating plants for service abroad. When territory is taken from the enemy, electrical service can be provided within 48 hours by running one or more of these trains on to sidings.

There are eight cars in one of these trains. The first two carry the condensers, which are designed for cooling by air because water will seldom be available where they will be operated. Four motor-driven fans draw air across the cooling tubes, and tests indicate that the full amount of steam can be condensed even with air at 95°F. It is expected that only 3 percent of the boiler feed water will have to be replenished with make-up. In the third car are the generator and the switchgear equipment, and the fourth and fifth contain auxiliaries and a day's supply of water. The boilers, which are designed for firing with any type of coal, occupy the sixth and seventh cars, and in the eighth are quarters for the operating crew and storage for lubricating oil, spare parts, etc.

These train power stations may be used to set up industrial plants in undeveloped regions or may be located in isolated sections that are not vulnerable to enemy bombing attacks. When the war is over, the equipment can be removed from the cars and put on foundations, or the trains can be held in readiness for emergency service.

Home-Front Safety

THE record of accidents in war plants is so appalling that it is hard to believe. Since Pearl Harbor was attacked, workers in the United States have suffered 7500 more fatalities than have occurred among our military forces. In addition, 210,000 have been permanently disabled and 4,500,000 temporarily, the total of the injured being 60 times greater than the wounded and missing in our armed forces. Deaths and injuries on the job in twelve months cause a loss in production equivalent to withdrawing 900,000 workers from the factory ranks for an entire year. Accidents account for four times as much lost time as strikes and cost employers on an average $35 a year for every man or woman employed.

As bad as the facts are, they represent an improvement over the first World War. This is attributed to the increased attention given to safety practices. Admittedly, however, there is still much to be done, and the Department of Labor is vigorously campaigning to reduce the 1944 accident toll by 40 percent. This goal can readily be reached if the safety efficiency that has been demonstrated by some companies can be extended throughout industry. At present, some of the worst records come from plants liberally plastered with "Safety First" signs which are evidently not backed up by organized safety measures.

Safety authorities say that 80 percent of the occupational accidents involve human failure, manifested as carelessness, or lack of knowledge or skill. Hazardous arrangement of equipment, improper guarding of machines, and unsafe dress also contribute largely to the toll, while two out of every three accidents are attributable to both personal and mechanical causes. The average worker knows that there are dangers, but he is prone to think that the other fellow and not himself will have a mishap. It is conceded that the general speed-up to increase production of war materials, coupled with long working hours, is responsible for the high accident-frequency rate.

Although the best safety records are made in privately operated plants, the general average is better in factories run by the Army and the Navy. Industry as a whole spends only a few dollars a year per worker for accident prevention, although it pays a bill of $35 a year per worker for accidents that happen. The chemical industry leads in this field with purchases of safety equipment of $6 per head, while in some major manufacturing plants the per capita expenditure is less than $1, according to the War Production Board.

The cost of accidents so far as the war effort is concerned is unbelievably huge. The total lost time to January 1 was 540,000,000 man-days, or enough to have built 7,500 average-sized merchant ships. This is more than twelve times the shipping lost in the Atlantic through enemy submarine activities. It is also estimated that the industrial equipment ruined through accidents was of greater value than all the cargoes sunk.

It is generally agreed that neither management nor labor alone can reduce accidents appreciably. A joint approach to the problem is required, and much time and effort must be devoted to educational programs. Ned H. Dearborn, executive vice-president of the National Safety Council, in which 6000 companies hold membership, says: "No industrial safety program can succeed unless there is a common determination on the part of management, supervision, and labor to prevent every accident. This determination must be reflected in a sound safety program, constantly and intelligently applied."

This and That

Halifax Has Crowds

In the days when "cussing" was outlawed in polite society, many persons who were too nice to use real swear words sometimes indulged in the expression: "Go to Halifax." It was considered a clever way of consigning someone to the nether regions without contaminating the tongue. In those times, relatively few persons ever actually went to Halifax, but not so today. That Canadian port is now so congested that E. L. Cousins, administrator of Canadian Atlantic ports, has issued a public appeal to people to stay away from the city unless they have to go there. Since the war started, Halifax has mushroomed from a community of 65,000 persons to one of 135,000 souls. The population of nearby Dartmouth has similarly grown from 8,000 to 17,000 persons. Housing accommodations are virtually unobtainable in the entire area, so Mr. Cousins has reversed the old saying and is now urging, "Don't go to Halifax."

* * *

Chance Discovery Useful

When experiments were being conducted eighteen years ago with natural-rubber latex as a material for waterproofing raincoat fabrics, pinholes of almost microscopic size mysteriously appeared after the cloth had been heated to dry it. Investigation revealed that the holes were caused by miniature explosions of air that had been trapped within the mesh of the fabric. The heat caused the air to expand and to break through the latex film that covered the cloth.

A way was found to prevent this, and satisfactory raincoat material was produced. At the same time, laboratory technicians of the United States Rubber Company were fascinated by what they had learned and conducted further experiments to determine how many holes they could create in a latex film. Eventually they succeeded in blowing as many as 6400 per square inch in sheets up to 42 inches wide and 20 yards long. Some one suggested that the sheets with their millions of minute perforations could be used as filtering media, and that is what is now being done. The product is known as multipore, and its field of service is being continually expanded.

Fruit juices shipped to our fighting units are filtered through multipore, which also is indispenable in the preparation of blood plasma. It serves in a new process for silver-plating airplane-engine bearings that has cut down the time requirement from 6½ to 1½ hours. Production of soft coal in individual mines has been increased as much as 300 tons a day by filtering out dust that was formerly lost with the processing water. Further, the material is successfully used by a steel company in connection with the concentration of iron ore by the flotation method.

The present method of making multipore is to spread latex on a cured-rubber blanket in which the desired number of microscopic pits has been produced, the air trapped in each pocket expanding and puncturing the latex. These filter screens are manufactured of either hard or soft rubber and may be compounded to resist abrasion, high temperatures, alkaline and acid solutions, as well as some oils and greases.

* * *

Soap Gets into Industry

In addition to its familiar uses in the household, soap is an important industrial material. It has long served the textile, leather, paper, and metal trades, and new roles are being found for it all the while. For example, it is estimated that the synthetic-rubber industry will require 100,000,000 pounds of it annually. According to an article in *Domestic Commerce*, published by the U. S. Department of Commerce, approximately 6 pounds of soap is needed to make 100 pounds of Buna-S rubber; and in one plant alone about 20 tons of soap flakes are consumed daily to make emulsions for the polymerization of synthetic rubber.

Soap greases the ways down which new battlecraft and cargo ships slide to their launchings. On the high seas, buckets of soapsuds are poured on overheated bearings. In converting scrap paper into usable material, soap removes ink, oil, and other unwanted matter. To protect metallic parts of airplane engines, guns, automotive equipment, and other war machines from corrosion they are first washed with organic solvents and then with soap. The addition of soap to petroleum oils solidifies them into grease that will adhere to surfaces and as much as 60 percent of which enters into greasing compounds used in railroad car journals.

Prior to the war, the textile business was the largest industrial consumer of soap. Impurities in raw materials, ranging from 5 percent in cotton and flax up to 30 percent in silk and to 50 percent in wool, are washed out with soap. From there on throughout the manufacturing processes, soap washes out greases and oils, disperses dyeing reagents, softens rayon fabrics, and does many other needful things. The leather industry also is a big soap user. Tanning removes the natural fat from hides and leaves them stiff and unpliable. Soap restores many of their original properties. Leather dressings, shoe polishes, and leather cleaners all contain goodly quantities of soap. The paper on which these words are printed was made smooth with the aid of soap. Sizing materials, which may contain clay, starch, chalk, etc., are applied to pulp paper to fill up minute surface irregularities and give the sheet a uniform appearance. In many instances they are held in suspension by means of soap solutions, and these enable them to be spread on the paper as a thin film.

Soap has long served as a lubricant for dies through which wire is drawn. More recently it has come into use in the flotation process for separating ores from their gangue materials and from one another. Soap solutions make good carrying liquids for all minerals except sulphides. Because soapy water has good adhering qualities, soap is added to fungicides, insecticides, etc., that are sprayed on leaves or grass. A wax-soap compound is sometimes sprayed on fruits and vegetables to make them keep longer. Another soap-base spray renders coal dustless. Truly, the industrial uses of soap are legion.

* * *

Safer Seismic Shooting

In seismic prospecting of the earth's crust for oil or other mineral deposits, a hole is drilled and explosive placed close to the bottom. The charge is connected to a firing circuit, the firing circuit to a recorder, and the recorder to several seismometers. When the explosive is set off, waves travel through the rocks, and the time it takes them to reach different points is recorded. In the past, the explosive was fired by wires extending down the hole, which may be as much as 450 feet deep. If there were power lines nearby, it sometimes happened that the wires were blown across them, and if they were still connected with the blasting machine, the operators there or even at the recorders occasionally suffered severe electrical shocks. In several instances there were fatalities. This hazard has been largely averted by use of the Primacord detonating fuse either alone or in conjunction with the wires. The fuse has an explosive core and destroys itself, or it can be arranged so that it will break the wires. It is reported that Primacord, which was developed by Robert L. Klotz, Jr., of the Hercules Powder Company, has greatly reduced the danger associated with this type of work.

Plastic Removes Carbon

NOT A SCRATCH IN A CHARGE

Shown here are granulated pellets of Tenite I, a plastic, which are used by our Army air forces to remove carbon from pistons and piston-ring grooves.

PLASTICS certainly are the wonder material of the age, and the list of varieties is as long as that of its uses. Among the newest of its applications is one of an unusual nature that is of considerable importance to our flying forces because it has greatly simplified the work of removing carbon from piston walls and piston-ring grooves. To be brief, they are cleaned by blasting with pellets of Tenite, a plastic made by the Tennessee Eastman Corporation. Originally, the carbon was softened by immersion in chemicals; and later it was found that it could be blasted off by clover seed and certain cracked grains. But these were scarce and had a relatively short service life. Then Tenite was tried and found to be highly satisfactory.

The blasting unit used consists of a sheet-metal box surmounting a large funnel and has a glass window, through which the operator can watch what he is doing, and two openings through which the work and the nozzle are introduced. Long sleeves that fit snugly around the operator's wrists are attached to these openings and serve, in combination with gloves, to protect him from the flying particles and to keep them confined within the cabinet. A charge consists of 50 to 60 pounds of 1/16-inch Tenite for cleaning pistons and a mixture of that and smaller sizes for piston-ring grooves.

The pellets are delivered to the nozzle through a flexible hose with air at from 80 to 100 pounds pressure that is controlled by a foot valve. The force with which they strike the work is said to be sufficient to knock off the carbon but not to pulverize the pellets or to scratch the metal. The spent material falls through a grate into the hopper and is recirculated. One charge is good for three days.

Power-Driven Masonry Saw

THOSE of us who have tried to shear a brick in half by striking it with a trowel, chisel, or other sharp-edged tool know how difficult it is to produce a square, even cut. In most instances, if the operation is at all successful, the surfaces will be ragged, bumpy, irregular. The number of good bricks that have been ruined by this method is beyond conjecture. However, such wastage is now avoidable it is claimed. By means of a device known as the Clipper Masonry Saw, it is possible to effect straight, clean cuts through firebrick, silica brick, dry-press clay, glazed tile, terra cotta, sewer pipe, coping tile, cement blocks, and many similar substances. The tool should therefore prove of great assistance in the construction and maintenance of electric, blast, and open-hearth furnaces, as well as to boiler mason contractors, to operators of rotary kilns, etc.

NO MORE CHIPPING

The saw that cuts firebrick and masonry blocks of all kinds to fit, thus saving time in structural operations and in lining blast and other types of furnaces. It is designed to make a series of shallow cuts so as to eliminate frictional heat.

The saw consists essentially of a circular blade that rotates on a shaft driven by a small electric motor (1 or 1½ hp.). It will make not only the conventional crosscut but also cuts at different angles, thus providing blocks of varying sizes and shapes—blocks that mean tight, smooth, uniform joints. As many as 24 types of blades are available in the Clipper line to meet a wide range of requirements. A steel ring is built into every blade and serves to protect the rotating shaft. Cuts range in maximum depth from 5 to 6½ inches.

Usable Rubber Hose from Worn Hose

BY SPLICING undamaged sections of discarded air-brake and air-signal hose, the Canadian Pacific Railway, with its 84,139 pieces of rolling stock, expects to reduce its annual demand for such rubber hose by as much as 30 percent. When the reclamation program was first adopted, each piece of worn or burst hose with enough good material left in it for splicing was placed in a miter box and cut by hand with a saw. That method was too crude and too slow and was soon abandoned for a special air-operated machine that incorporates those features. It was assembled at the Angus shops in Montreal, Que., under the direction of H. R. Naylor, works manager, and consists essentially of an air-operated knife blade that is lubricated to insure a clean cut, of a self-locking clamp that holds the work steady, and of a measuring device to assure sections of correct length. The pieces are joined by a malleable-iron adapter and permanently secured by clamps. The 2-piece hose is said to meet all safety requirements and to stand up well in service. According to *Canadian Transportation*, it has been possible through the salvage of 6452 hoses to save 5½ tons of rubber.

CUTS RUBBER HOSE

This machine was built from an old hack-saw blade and other secondhand materials to salvage air-brake and air-signal hose. The adapter and clamps used to join short lengths cut from worn or burst hose are shown at the bottom.

Industrial Notes

Where wooden steps are needed on outdoor construction jobs they are apt to become slippery in wet weather. Nailing a strip of ¾-inch rope along the outer edge of each step is a simple expedient that may prevent accidents.

A new fiber gasket material is being supplied by the Armstrong Cork Company in rolls, sheets, or cut to specifications. Designated No. 743 Fiber Sheet Packing, it does not, it is claimed, corrode alloys of aluminum, magnesium, steel, zinc, and copper in the presence of moisture or salt spray.

A thermometer that gives readings in both Fahrenheit and Centigrade has been put on the market by the Rochester Manufacturing Company. The instrument is circular and registers temperature variations through the medium of a bimetallic element. Readings range from −90 to +130°F. and from −70 to +56°C.

Raw and fabricated materials, standard parts, motors, hardware, fabrics, precision tools, equipment, and other surplus stocks are being offered for sale by the Army Air Forces. Companies desiring to have their names placed on the active bidders' list are invited to write to the Army Air Forces, Matériel Command, Midcentral Procurement District, 111 West Jackson Boulevard, Chicago 4, Ill., attention of the Redistribution and Salvage Section.

Under the name of Stripcoat, the Dow Chemical Company is offering a plastic packaging material for finished metal parts. It comes in the form of slabs and is melted in dipping kettles maintained at a temperature of 350-375° F. When dry it forms a tough protecting film that can be cut with a pocketknife and strips off clean.

With linen and long-staple cotton beyond our reach, research men lost no time when the source of supply was cut off trying to produce yarn from our own short-staple cotton that would be suitable for weaving harness for paratroopers. In this they have succeeded. We are told that the new thread is as tight and strong as that made of linen and that it it highly resistant to weathering and mildew.

Industry is forced to resort to many makeshifts that are worth broadcasting because they may help out someone else in a pinch. A pneumatic brake with remote control, made up of parts salvaged from scrapped machinery, comes within this category. It was devised by a machinist in the General Electric Company's Schenectady Works when the locking device built into the rotary table of a large drilling, boring, and milling machine became worn and would no longer hold. The brake consists of a leather-lined metal band placed around the base of the table. One end is bolted to the frame, while the movable end is attached to it through the medium of a lever actuated by an air cylinder. At the forward stroke of the plunger the brake is applied, and when the piston is retracted the brake is released. The air supply is controlled by a 3-way valve that permits the operator to revolve and lock the table and to start and stop the drill from one point.

Among the many materials and products promised the general public in the postwar era is nylon rope that, if claims made for it are true, has many advantages over manila rope. Weighing less than half as much as manila rope of equal size, it is also said to be resistant to mildew and salt water, as well as to

A PEEK INTO POST-WAR PIPING

TOMORROW'S MINING REQUIREMENTS CALL FOR THESE NAYLOR ADVANTAGES!

- Always accurate in diameter.
- Concentric ends match correctly.
- Easier to install.
- Holds true cylindrical form.
- Stays tight and leakproof.
- Stronger—safer.
- High salvage value.
- Light weight saves steel.
- Cuts maintenance costs.
- Saves money.

Sizes: 4" to 30" in diameter—all types of fittings, connections and fabrications.

To do your piping jobs better, easier and more economically promises to be a war by-product that will work wonders in the post-war period. The outstanding performance of Naylor light-weight pipe on the battle fronts, plus the research and development work constantly in progress point the way to the solution of many mine-piping problems in the future.

Write for Naylor Catalog

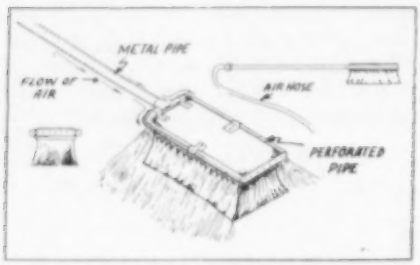
Naylor

LOCKSEAM SPIRALWELD PIPE

NAYLOR PIPE COMPANY
1245 East 92nd Street
Chicago 19, Illinois

possess the unique property of stretching rapidly under the stress of a sudden pull and recovering from it slowly but steadily. A nylon line 1½ inches in diameter can lift 3 tons.

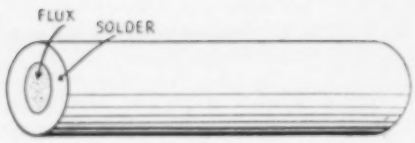
Shown in the accompanying drawing is a tool that was devised by one of the men in the paint shop of the Murray Corporation of America. It is both a time and a labor saver and obviates the



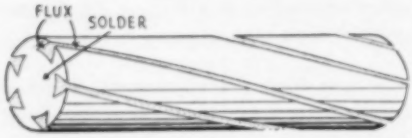
need of climbing on airplane wings after the United States insignia—a 5-pointed star in a circle—has been painted on them. In the case of a *Flying Fortress* the design is 6 feet in diameter. When this spray-paint job is finished, the uncoated surfaces are covered with paint dust, and this was formerly wiped off with a cloth. Now, the operator can reach every part of a wing from his station with the long-handled combination brush and blower.

Motorcote is recommended as an aid to winter motoring and consists of a cork mixture formulated by the J. W. Martell Company. It is applied by air spray to the engine oil pan and crankcase, forming an insulation 1¼ inches thick that is said to shorten warm-up time, virtually to eliminate water condensation and crankcase dilution, to resist vibration and rough going, and to remain unaffected under a temperature range of −60 to +250°F. Primarily developed for military use in the Arctic, the coating is now generally available.

Under the name of Fluxrite, the National Lead Company has introduced a new kind of fluxed wire solder. As the accompanying drawing shows, the flux is contained in lengthwise grooves in the surface and not in the form of a core, as formerly. The advantages claimed for the product are: First, the flux liquifies and flows onto the work before the solder melts, thus insuring complete fluxing with consequent stronger and better welds; and, second, there is no interruption in the flow because the flux is in a number of grooves and any voids



CONVENTIONAL FLUX-CORE WIRE SOLDER



NEW TYPE OF WIRE SOLDER WITH FLUX IN GROOVES

or gaps in the supply, being visible, can be guarded against. Fluxrite comes in the same diameters as regular cored solder and in two compositions that can be readily identified by the color of the flux, which is red and green, respectively.

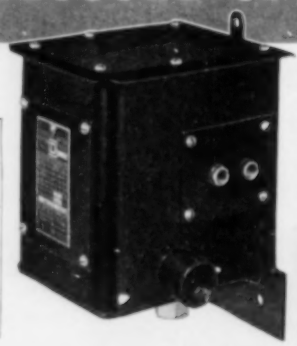
At the largest of the three reclamation depots maintained by the Standard Oil Company of California, savings effected through industrial salvage run into large figures. Among other things, about 24,000 feet of oil-line piping is reconditioned there weekly. This involves passing the sections through furnaces to burn off scale and sludge, cleaning by sandblasting, and straightening in an air-operated press.

Marine PRESSURE SWITCHES

DRIPPROOF AND WATERTIGHT
HIGH SHOCK CONTACT BLOCK—
TWO OR THREE POLE—CLASS 9013
TYPE AW-H, MW-H, LW-H

ELECTRICAL RATINGS

Voltage	Single Phase A.C.	Polyphase A.C.	D.C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	.....
32V.	.....	.....	½ H.P.



● Built for Marine Service to conform with requirements for dripproof and watertight devices of shockproof construction. The switches differ from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block in two or three pole form. The three types AW-H, MW-H and LW-H represent three diaphragm sizes and three range and differential variations. A release valve for air compressor service may be added to any of the types, as illustrated. Write for Bulletin 562.

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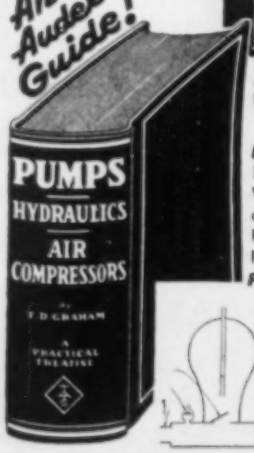

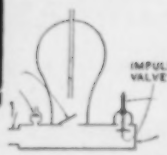

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One high standard of quality throughout . . . One source of supply . . . One responsibility for all materials

WHEN you need a single fitting or a piping system, you stand a better chance of getting exactly what you need from Crane. The unusual completeness of the Crane line sees to that—as indicated by this boiler feed hook-up. Not only the valves and fittings, but all pipe, pipe bends, and other materials are supplied by Crane.

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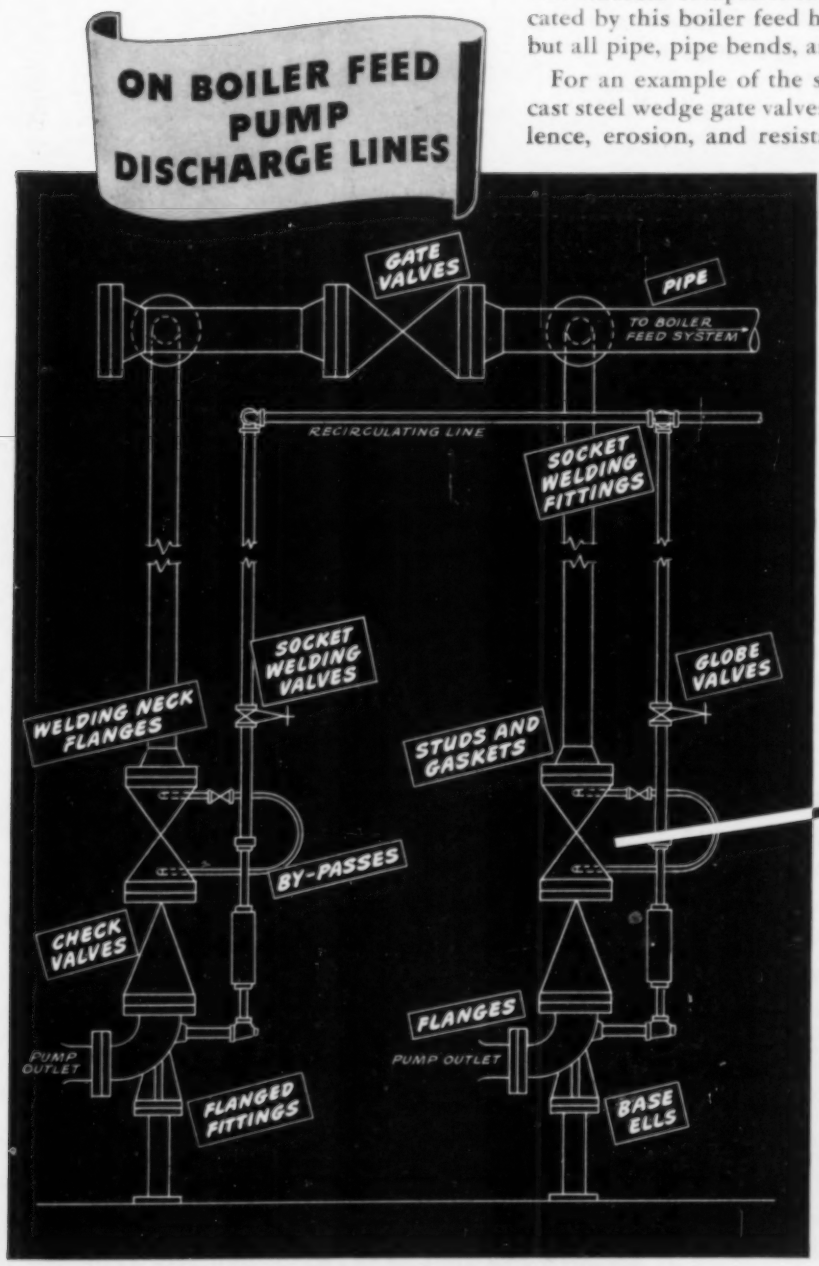

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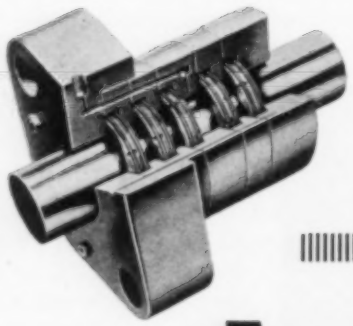
VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

COOK'S METALLIC PACKINGS



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of all Engines
and Compressors

Experience Counts..

SEALING PRESSURES SINCE 1888

WHEN introduced in 1888, COOK'S Metallic Packing was a radical departure from the means in vogue at the time for packing piston rods. But progressive minded engineers of the day at once recognized the decided advantages of these new packings with the result their use rapidly grew in favor and multiplied from year to year until today COOK'S Packings are in operation throughout the world. Now back of COOK'S Packings is the experience of 56 years devoted **exclusively** to their development and production by management, engineers and skilled workers who have made it their life's work. These packings are the product of a modern plant equipped with the finest tools and unique in having its own foundry. The plant is self-contained and self-sufficient except for the purchase of raw materials and stable items such as screws and nuts.

Precision manufacture in COOK'S plant means not only working to close tolerances and the development of ground and lapped surfaces, but the scientific control of all its materials and operations from foundry to shipping.

Then too, COOK has thoroughly trained service engineers in many vital industrial centers—engineers who know packings—the result, in many cases, of over twenty years' **practical experience** in close contact with actual operation in the field. Yes, Experience Counts . . . the combined experience of design, production and service engineers. And when you order COOK'S Packings you not only reap the benefit of this experience, but you obtain Packings sold with the understanding "our responsibility starts with operation."

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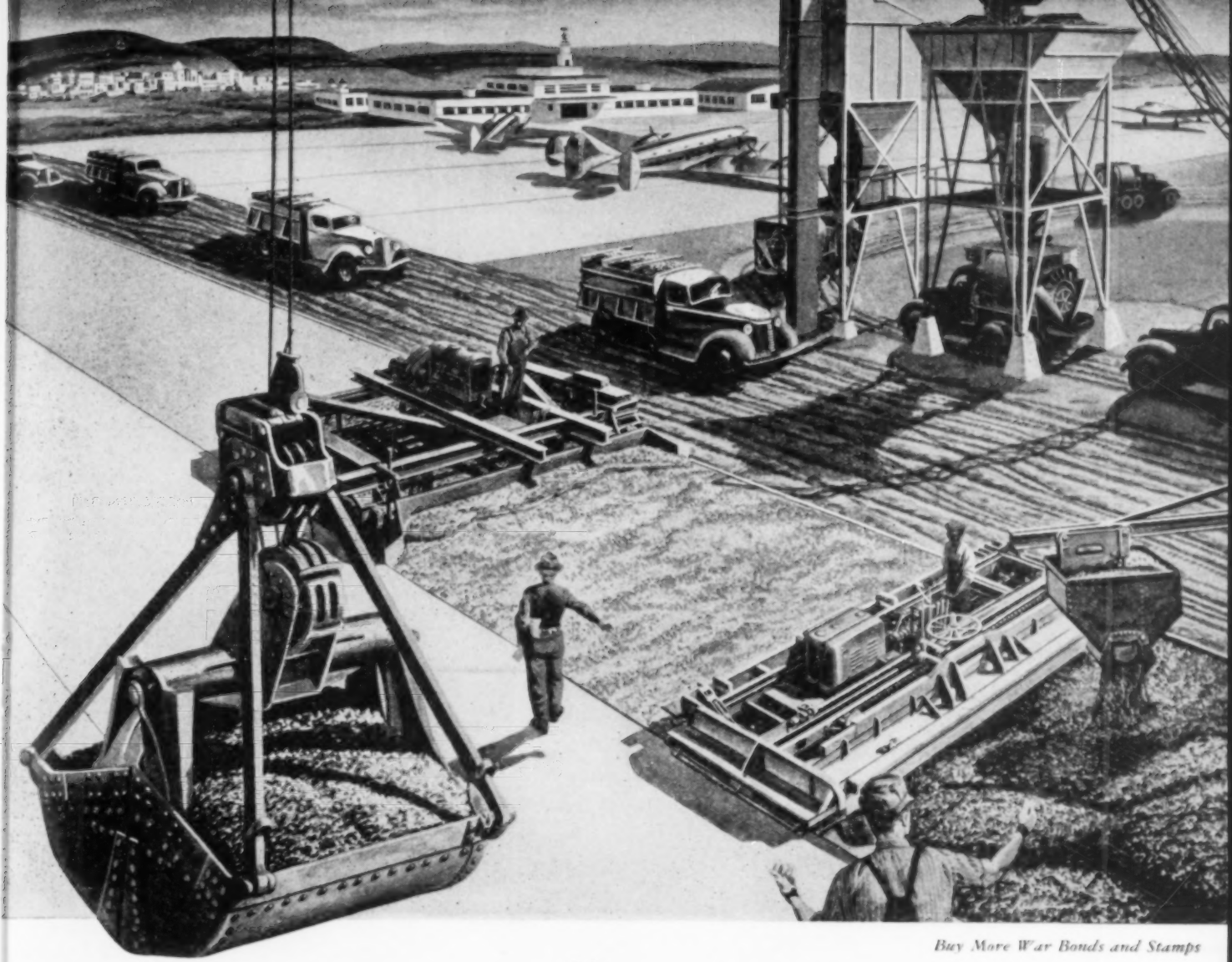

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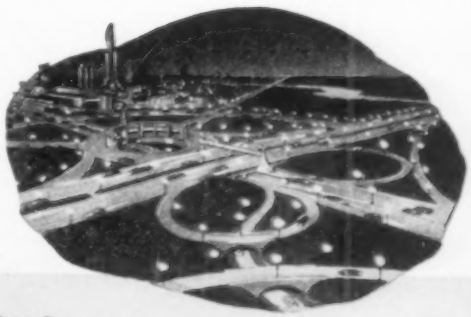

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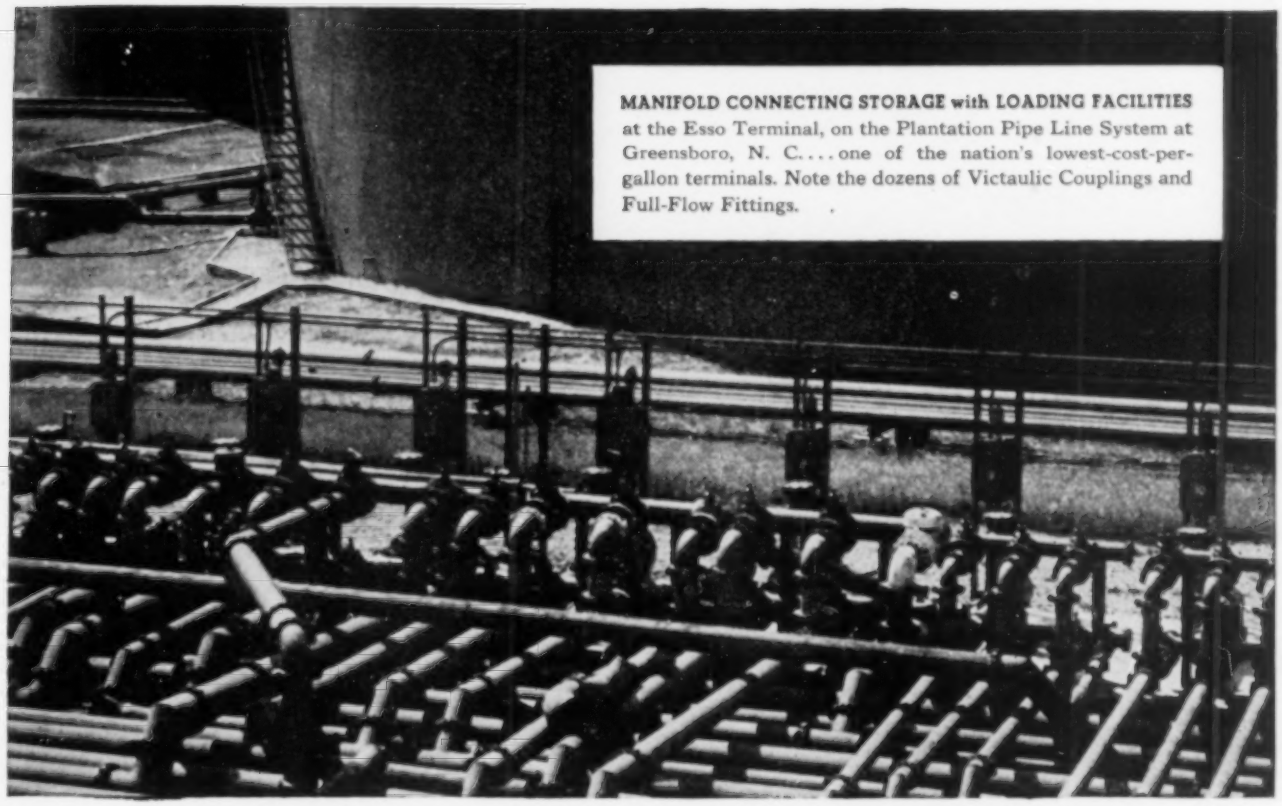

MANIFOLD CONNECTING STORAGE with LOADING FACILITIES at the Esso Terminal, on the Plantation Pipe Line System at Greensboro, N. C.... one of the nation's lowest-cost-per-gallon terminals. Note the dozens of Victaulic Couplings and Full-Flow Fittings.

Victaulic... and one of the world's most efficient oil terminals!

IN WARTIME, when oil is so all-important, this modern bulk storage plant at the Greensboro, N. C. terminal of the Plantation Pipe Line System—one of the first war-emergency pipelines—can be especially proud of its efficiency! Day after day it is handling oil in a volume far in excess of the original plan. Throughout this terminal, a stand-out example of modern practice, you'll find Victaulic!

Manifold arrangement with Victaulic Couplings and Full-Flow Fittings. Fast, self-aligning, the couplings permit angular deflection. Leak-tight, self-sealing under pressure or vacuum. Every joint an expansion joint and a pipe union with positive mechanical lock.

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★ Can be installed faster and with less labor than any other method!

★ Lower installation costs... unskilled labor can do the job.

★ No expensive equipment needed... one small wrench is the only tool required.

★ Substantial savings in space and weight.

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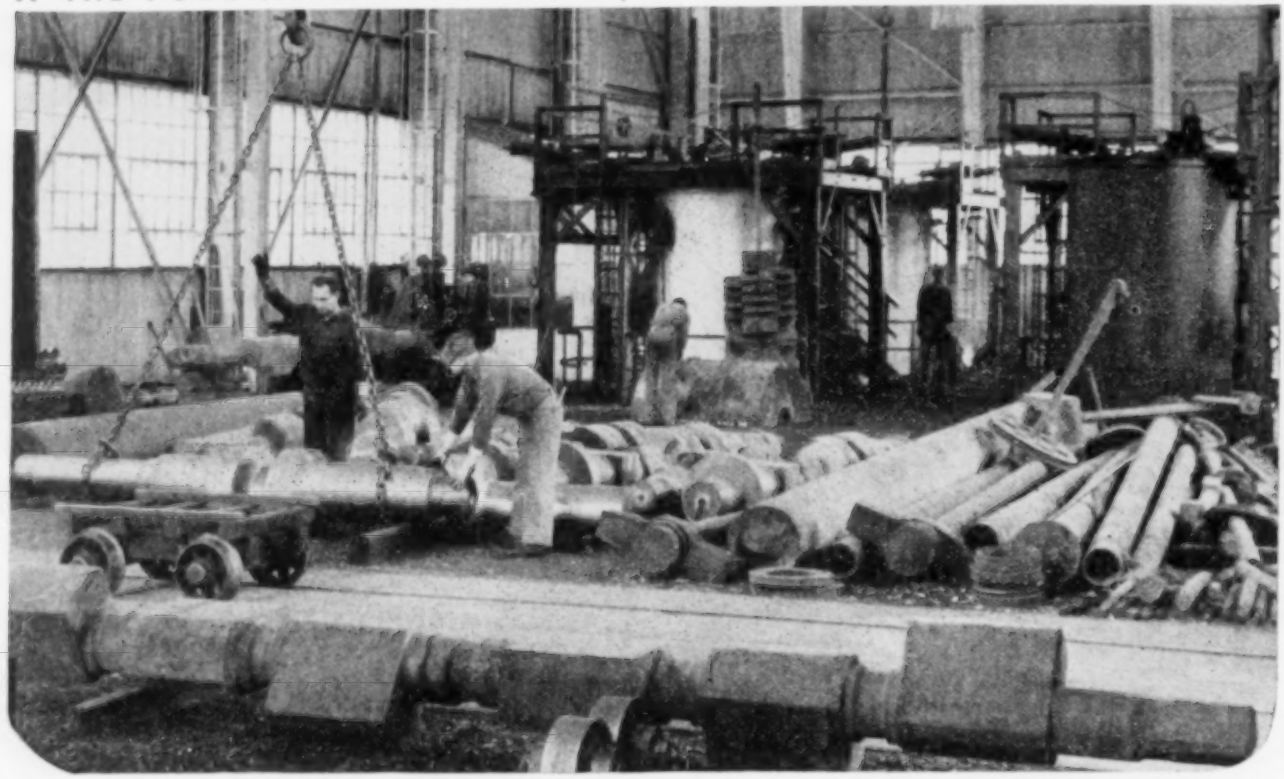
IF THE FORGING IS HEAVY DUTY, IT SHOULD BE NATIONAL FORGED



National Forge's expanded heat treating facilities represent the latest developments in modern heat treating methods.

Forgings are Fortified IN THEIR ORDEAL BY FIRE

IF you would know the inner character of a steel forging, know how it is heat treated. No step in the National Forging Process receives more exacting attention.

Although National Forge makes its own basic electric steel and the press forming of the forging is in the hands of forgesmiths of long acquired skill, heat treated National Forgings receive thorough treatment involving the most modern metallurgical techniques. National Forge designed its heat treating furnaces in the knowledge that for overall uniformity and avoidance of internal stress, the furnace must always be suited to the nature of the forging.

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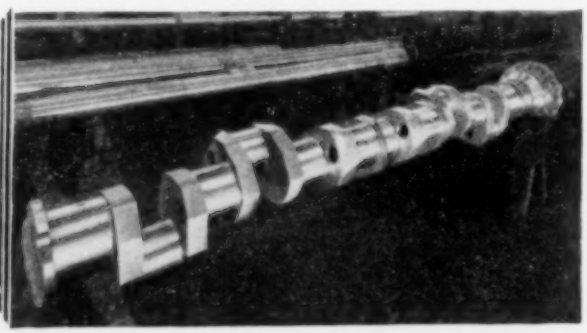
Experienced users of heavy duty steel forgings know they can depend on National Forge for full and correct heat treatment—a factor so important in itself, that it frequently justifies the decision if the forging is heavy duty, it should be National Forged.

This Diesel Crankshaft demanded heat treatment of the most exacting character to enable it to withstand the high torque stresses of modern Diesel operation.



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"WE MAKE OUR OWN STEEL"

For Excellence E *in Production*

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THESE COMPRESSORS ARE NOT MERELY *Anti-frictionized*—THEY ARE *Timken Bearing Equipped*

Will you be ready for post-Victory competition? Make sure of it now—redesign your equipment to use more Timken Bearings.

It isn't sufficient to specify merely "anti-friction bearings" when purchasing an anti-frictionized compressor of any type; for then you might not receive *all* the anti-friction advantages to which you are entitled.

The surest way to get them all is to specify "Timken Bearing Equipped"—that means smooth operation; power economy; protection against radial, thrust and combined loads; permanent alignment of moving parts; low maintenance expense.

Ingersoll-Rand, two of whose Model 40-M Motor Compressors, equipped with Timken Tapered Roller Bearings on the crank shaft, are shown in the photograph, have used Timken Bearings for years; know they can be depended on for efficient, enduring service. The Timken Roller Bearing Company, Canton, Ohio.

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TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

New *Efficiency* for old condensers

TODAY'S REQUIREMENTS are for *higher* water velocities — *higher* temperatures — *higher* pressures—heavily increasing burdens on condenser tubes. **JOHN CRANE CONDENSER PACKINGS** are engineered for *duties now, and in the future.* You will find that the *most efficient* condensers have John Crane **CONDENSER PACKING** . . . used on hundreds of ships and stationary installations.

THESE ARE THE ADVANTAGES

- Easy to install—no special tools required
- Permit quick renewals of tubes in operation
- Reduce cost of retubing and repacking
- Bond tubes to sheets, reducing electrolytic action
- No deformation of tube ends, as by ferrule pressure
- Eliminate costly ferrules
- Permit free expansion and contraction of tubes in temperature changes
- Seal tubes tightly in all heat transfer equipment
- Outlast life of tubes
- Not affected by contaminated or chemically treated water

Remarkable progress has been made in condenser efficiency, and the Crane Packing Company has pioneered every improved condenser packing development. Write for this story and descriptive literature.

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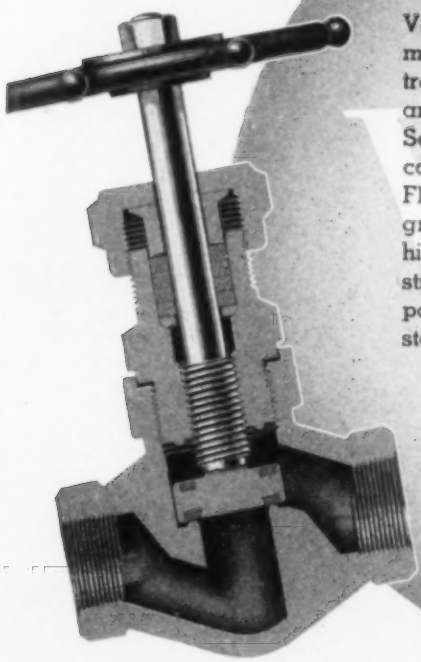
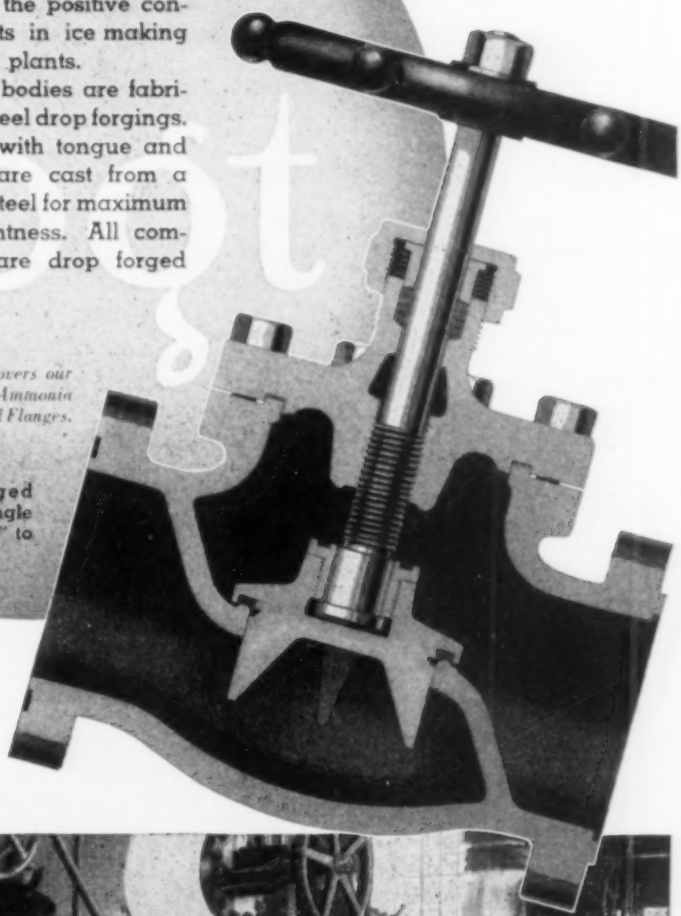


Vogt builds a complete line of ammonia valves for the positive control of refrigerants in ice making and refrigerating plants.
Screw end valve bodies are fabricated from solid steel drop forgings. Flanged bodies, with tongue and groove facings, are cast from a high grade semi-steel for maximum strength and tightness. All companion flanges are drop forged steel.

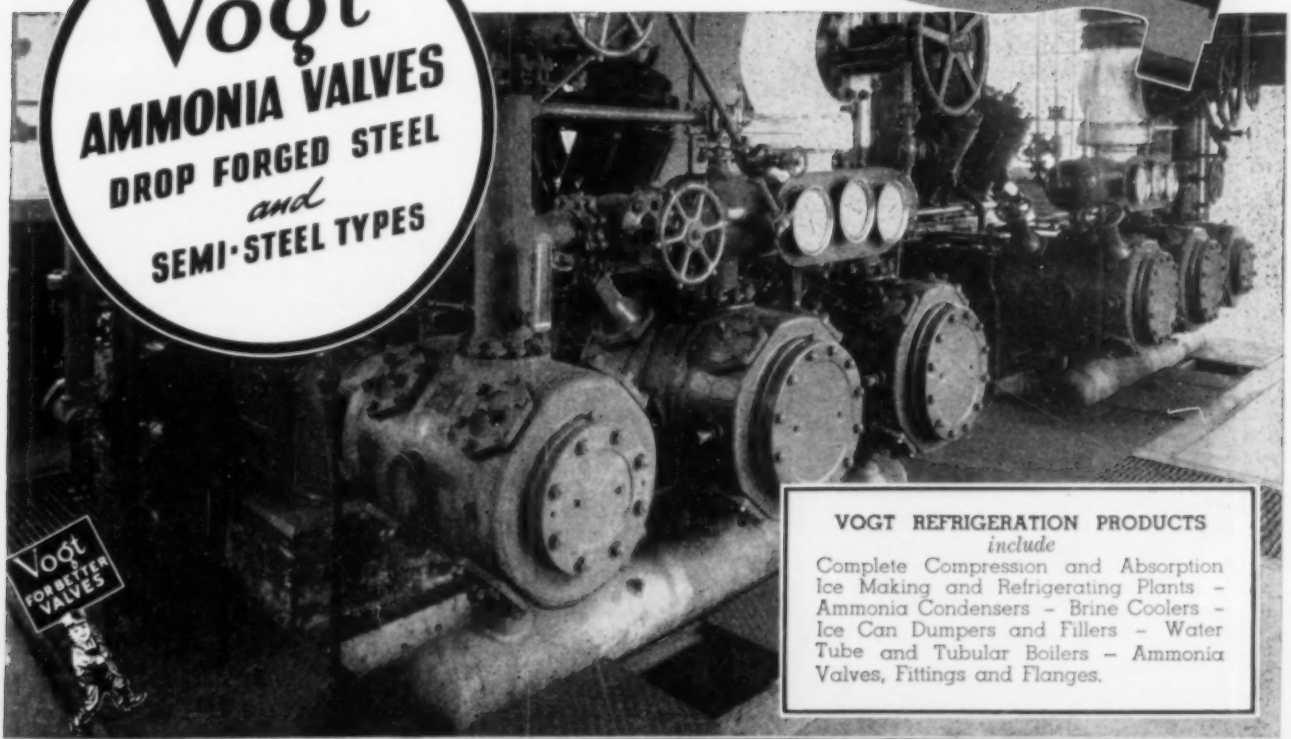
Catalogue AE-2 covers our complete line of Ammonia Valves, Fittings and Flanges.

(*Right*) **Flanged Globe and Angle Valves from 1/4" to 10" inclusive.**



(*Above*) **Screw End Globe and Angle Valves from 1/4" to 2" inclusive.**

Vogt
AMMONIA VALVES
DROP FORGED STEEL
and
SEMI-STEEL TYPES

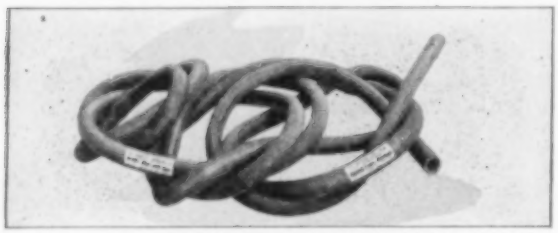


VOGT REFRIGERATION PRODUCTS
include
Complete Compression and Absorption Ice Making and Refrigerating Plants – Ammonia Condensers – Brine Coolers – Ice Can Dumpers and Fillers – Water Tube and Tubular Boilers – Ammonia Valves, Fittings and Flanges.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY. *New York - Philadelphia - Cleveland Cincinnati - St. Louis - Chicago - Dallas*

Condor AIR HOSE
HOMO-FLEX

with FLEXLASTICS* and balanced, engineered construction



Condor Homo-Flex Air Hose is a new type hose—rugged, light in weight and flexible . . . it will not kink, coil or twist. Made with a thick inner tube to resist the deteriorating effects of oil and coupling wear. Has super-strength cords embedded in FLEXLASTICS* to form the Strength Members . . . and a heavy, abrasion-resisting cover of FLEXLASTICS* to give Condor Homo-Flex Air Hose great strength and resistance to high working pressures.

Practically inseparable cover and plies; uniform inside and outside diameters; and resistance to elongation and expansion are other advantages.

51st YEAR

*The term FLEXLASTICS is a MANHATTAN trade mark. Only MANHATTAN can make FLEXLASTICS.

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.
Executive Offices — Passaic, New Jersey

Cut Air Tool Maintenance!

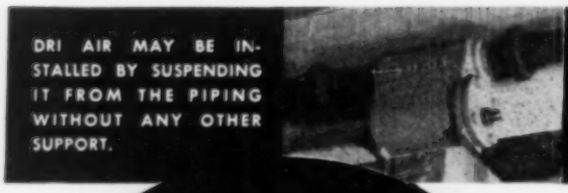
Moisture and dirt in compressed air lines does more damage to air tools, such as impact wrenches, grinders, tampers and chippers, than mishandling or actual long hour use.

Aridifiers remove all contamination from air lines by positive, centrifugal force. Nothing to wear, clog, replace or adjust. They cut air tool maintenance costs to the bone. Easy to install. Sizes for every requirement.

Send for Bulletin 543.

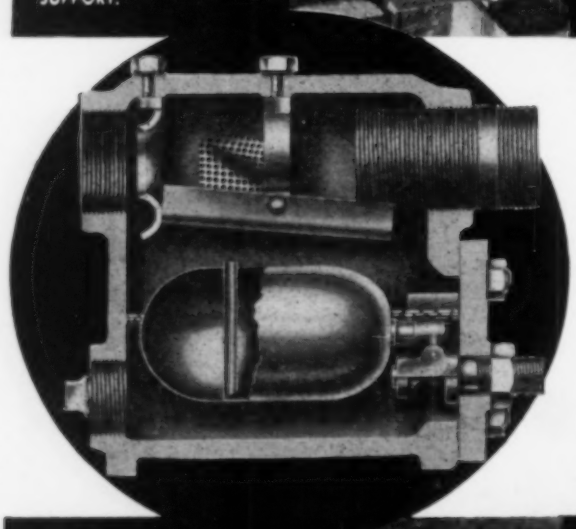
LOGAN ENGINEERING CO.
4911 Lawrence Ave., Chicago (30), Ill.
Makers of the Logan Lathe

The ARIDIFIER
Dries and Cleans Compressed Air



DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD, NEW JERSEY

PALS FOR YEARS

Ever since 1912, when Ingersoll-Rand brought out the first "Jackhamer," these machines have been "pals" of the men who operate them. Typical of the way drill runners feel about "Jackhamers"* is the following paragraph from a recent letter:

"I have used Jackhamers these past ten years and am proud to say that they are the best to handle and the fastest machines on the market. Give me an Ingersoll-Rand every time."

The JB-5, our "Jackhamer" in the 55-pound class, is the easiest-holding machine we have ever built in this popular size. Reports from the field prove that operators drill more feet of hole per shift with it because of the Easy-Holding feature. The man's energy is used to cut rock—not to fight, power-wasting, destructive recoil. Peak performance is maintained hour after hour throughout the length of the shift...and in addition, upkeep costs are lower because of the reduced vibration and smooth flow of power which is made possible by a refined valve action.

For further details on how the JB-5 can help you increase your footage, consult our nearest engineering service division.

*Only Ingersoll-Rand makes "Jackhamers" (registered I-R trademark).

SOLVE YOUR DRILLING PROBLEMS WITH IR JACKBITS

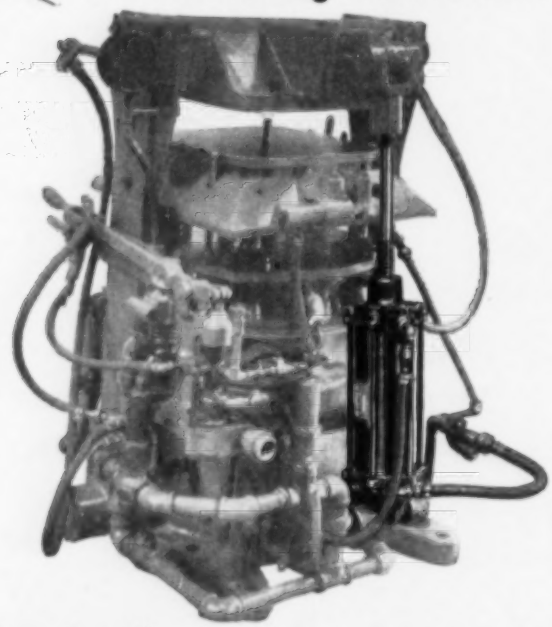
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

Feminine Touch

Controls Molding Machines



equipped with NOPAK Air Cylinders

On the Tabor Power Squeeze, Flask Lift Molding Machine, a NOPAK Model E 4½" Air Cylinder moves the 350 lb. head into position for the squeeze, then moves it back so the finished mold can be removed, and a new flask inserted.

Eliminating strenuous manual effort from this particular machine movement has made it possible to employ women on these machines . . . has speeded up the molding cycle to meet war production needs. A battery of these machines is production-molding piston rings for airplanes in a large, well-known foundry.

Perhaps NOPAK Cylinder Power can help you speed up movements on your machines. Write for Bulletin 82-A.

GALLAND-HENNING MFG. CO.
2759 S. 31st STREET MILWAUKEE 7, WIS.

NOPAK Jolt-Squeeze Valves are standard equipment on many molding machines, and may be used in the control of other types of machine movements. See Bulletin 86.

Representatives in Principal Cities

NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

A 4303-½

CROSBY CLIP *Safety and Economy*

GIVE THESE ADVANTAGES

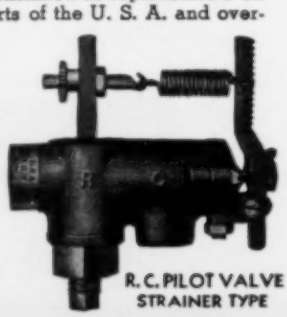
1. The Genuine CROSBY CLIP develops the full strength of the rope at lowest cost per fastening.
2. The Genuine CROSBY CLIP can be used over and over BECAUSE
   (A) U-Bolts and Nuts are over-size for extra strength. Threads won't strip. | (B) Base is drop forged steel. Resists distortion and fracture under heaviest loads. | (C) All parts heavily hot dip galvanized to resist rust.
3. Every CROSBY is a Repeater.

It will pay you to insist on the Genuine CROSBY CLIP.

AMERICAN HOIST AND DERRICK CO.
Chicago San Francisco New York
SAINT PAUL, MINNESOTA
1883 - 1943
AMERICAN TERRY DERRICK CO.
SOUTH KEARNY, N. J.
FOR SAFETY

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



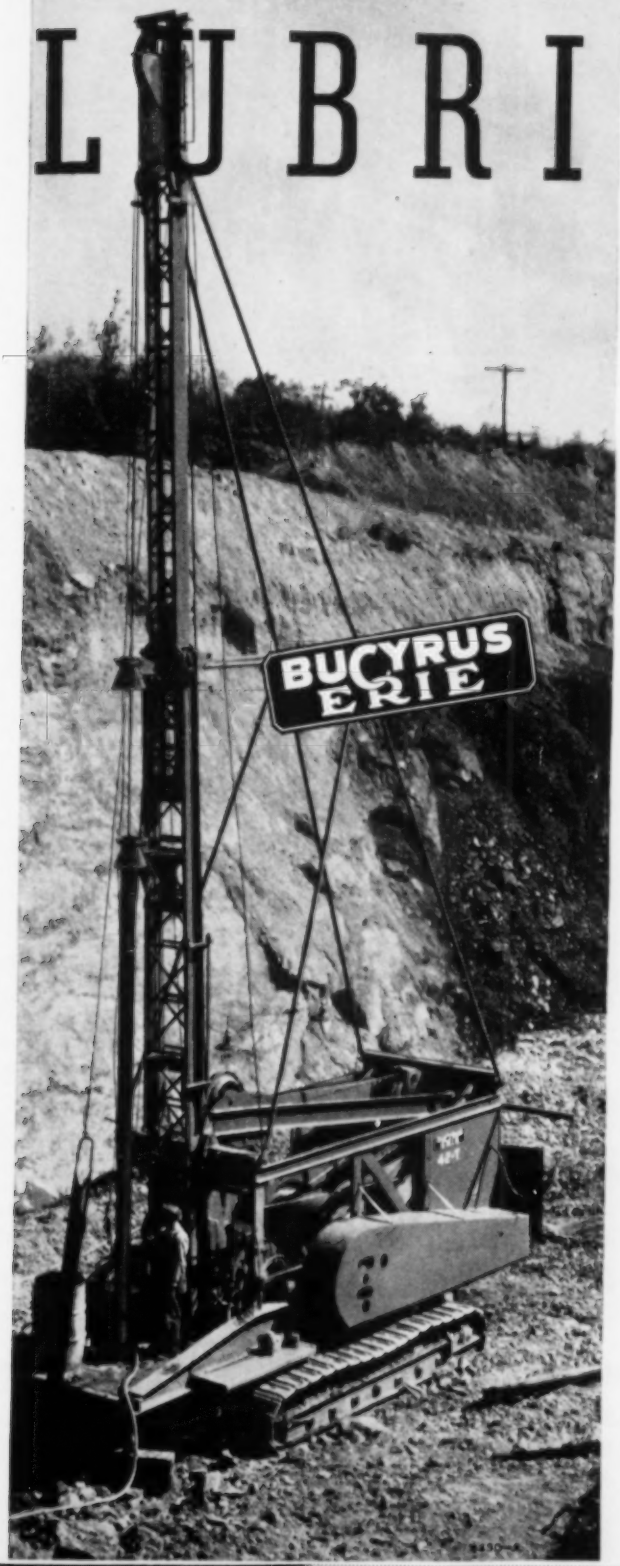
R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

Your Blast Hole Drill Needs

LUBRICATION

to last the duration!



You can do much to help your blast-hole drill endure the war years — while it's working its hardest and best — by lubricating it regularly. Be sure to follow carefully the complete lubrication instructions of your drill manufacturer, and you'll be well on your way to drilling as Uncle Sam likes it — at top speed for the duration.

Here Are Some Points to Watch:

1. Bearings on crown sheave and sand line sheave should be lubricated once each shift.
2. On modern machines lubricate ball or roller bearings on jackshaft and engine pulley shaft with small amounts about once each week. Don't use graphite grease. On older machines with plain bearings, lubricate daily.
3. If your machine is caterpillar-mounted, lubricate crawler fittings once each week, oftener when machine is propelling long distances. Even when your drill is not travelling, keep cats lubricated against wearing motion developed in drilling.
4. Keep wire lines lubricated with wire rope lubricant to prolong their life.
5. Be sure to lubricate spudding pinion and bull reel pinion once each shift.
6. Don't overlook sand reel shaft bearings and operating lever connections — they should be lubricated once each shift.
7. Get complete lubrication instructions from your drill manufacturer and follow them carefully.

Keep 'em Drilling

H-46

ARMY E NAVY

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

new... ELECTRONIC

Confirms Ability of Insulation to Withstand Shorts Due to Voltage Surges

• Now, a new electronic test shows *visually* that the insulation of every coil, every turn, and every phase of a G-E Tri-Clad motor winding has the strength to withstand the voltage surges that are a cause of shorts and grounds in service. Thanks to this new G-E development, no undisclosed insulation weakness can "get by."

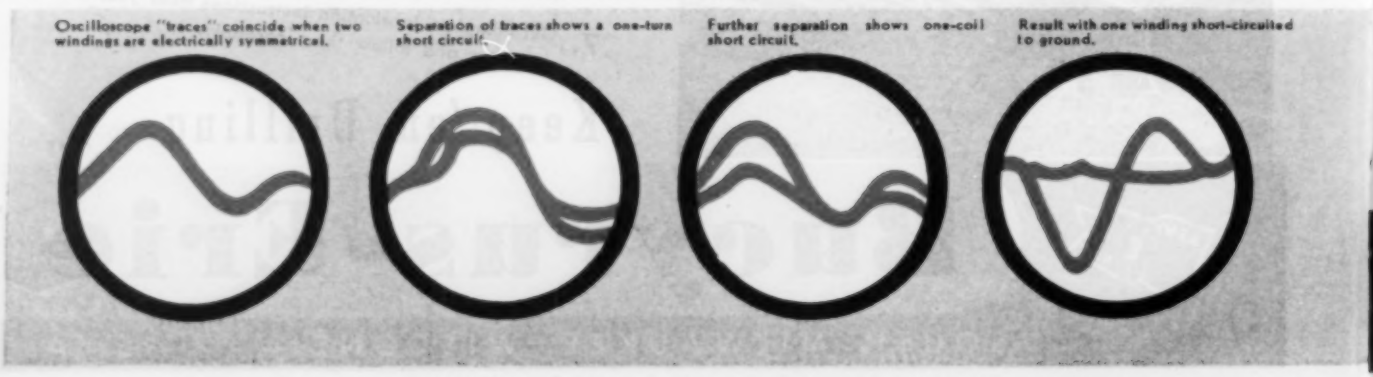
The new test method* subjects each coil in the assembled motor to a steep-front surge impulse, similar to a high-voltage transient of actual service. A cathode-ray oscilloscope indicates the performance of the winding under this sudden stress.

Only a motor with perfect insulation, and with the phases symmetrical, will give a single, clear-cut "standing wave" on the screen. The test indicates not only the condition of turn-to-turn insulation, but also that of coil-to-coil and coil-to-ground insulation.

This test is now applied to all G-E Tri-Clad motors, and to many other G-E motors and generators, as a regular step in production. Its advantages are so great that its use is widening throughout the motor industry.

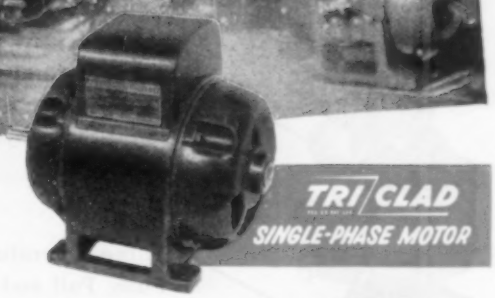
*For complete details, see "Insulation Testing of Electric Windings," Trans. of A.I.E.E., Vol. 62, pp. 203-206.

HERE'S HOW WINDING STRENGTH SHOWS UP ON THE OSCILLOSCOPE "WINDOW"


Oscilloscope "traces" coincide when two windings are electrically symmetrical.
Separation of traces shows a one-turn short circuit.
Further separation shows one-coil short circuit.
Result with one winding short-circuited to ground.

TEST Tells the "Inside Story" of Motor Windings

Production-line test of G-E Tri-Clad motors with new electronic tester. Operator turns transfer switch to take reading on each phase.

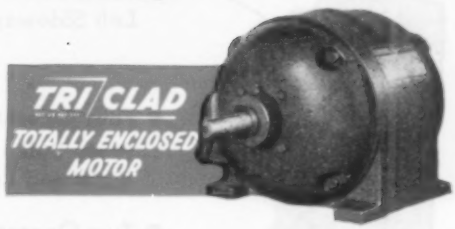


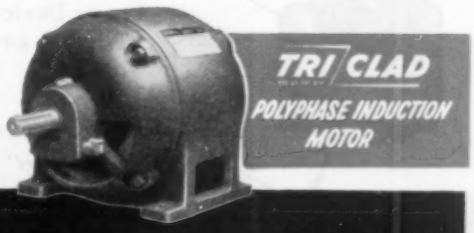
An Individual Check of Each TRI CLAD Motor Gives Extra Assurance of Unfailing Service

At each Tri-Clad motor factory, a production-line test setup like the one shown above is regularly in service. The motor windings are checked by this new test as an *additional* step in G.E.'s strict testing procedure. Other winding tests include the high-potential and high-frequency tests, in addition to many quality tests made on Formex* wire and other winding materials before they are used in the motor windings. Whenever you buy or specify a G-E Tri-Clad motor for your plant or machine, you get extra assurance of unfailing service. *General Electric Company, Schenectady, N. Y.*

*Reg. U. S. Pat. Office.

Every week 192,000 G-E employees buy more than a million dollars' worth of War Bonds.





GENERAL ELECTRIC

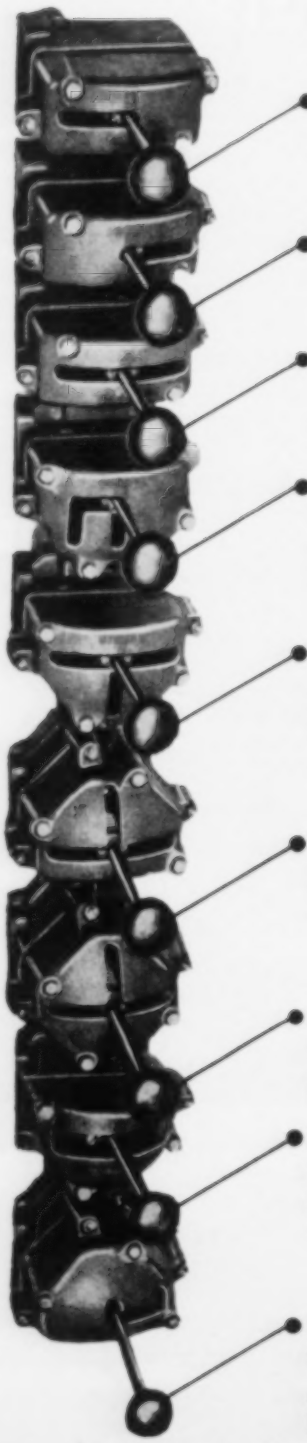
750-234-8030

FLEXAIR VALVES

For remote pneumatic control of cylinders, clutches, hydraulic couplings and other power mechanisms. Ideal for centralized, graduated control of operations on cranes, whirleys, shovels, oil drill rigs, hoists, dredges and production machines.

Stock valves available as shown. Other combinations to suit the installation.

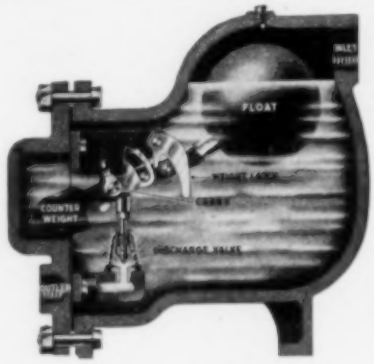
Ask for
Catalog IDC 9306-1



- Single Operation—Pull Type.
- Single Operation—Push Type.
- Two Operations—Push and Pull from Central.
- For Operating Two Power Devices—Either Singly or Combined.
- Three Operations—Push, Pull and Right Sideway.
- Three Operations—Push, Pull and Left Sideway.
- Four Operations—Push, Pull, Right and Left.
- Two Operations—Double Control of a Power Device with "Trip" at any Point.
- One Operation—With "Trip" at Release and Fully Applied Positions.

WESTINGHOUSE AIR BRAKE CO.
Industrial Division WILMERDING, PA.

★ *Nicholson Model "JR" Compressed Air Trap* ★



THIS TRAP

INCREASES THE EFFICIENCY OF PNEUMATIC TOOLS

NICHOLSON "Model JR" Compressed Air Traps are specially designed to provide long, trouble-free service in automatically draining air tanks, separators, receivers, after-coolers, etc. Water-sealed discharge valve, welded stainless steel float. Large capacity, pressures to 200 pounds. Intermittent discharge. Bulletin No. 341.

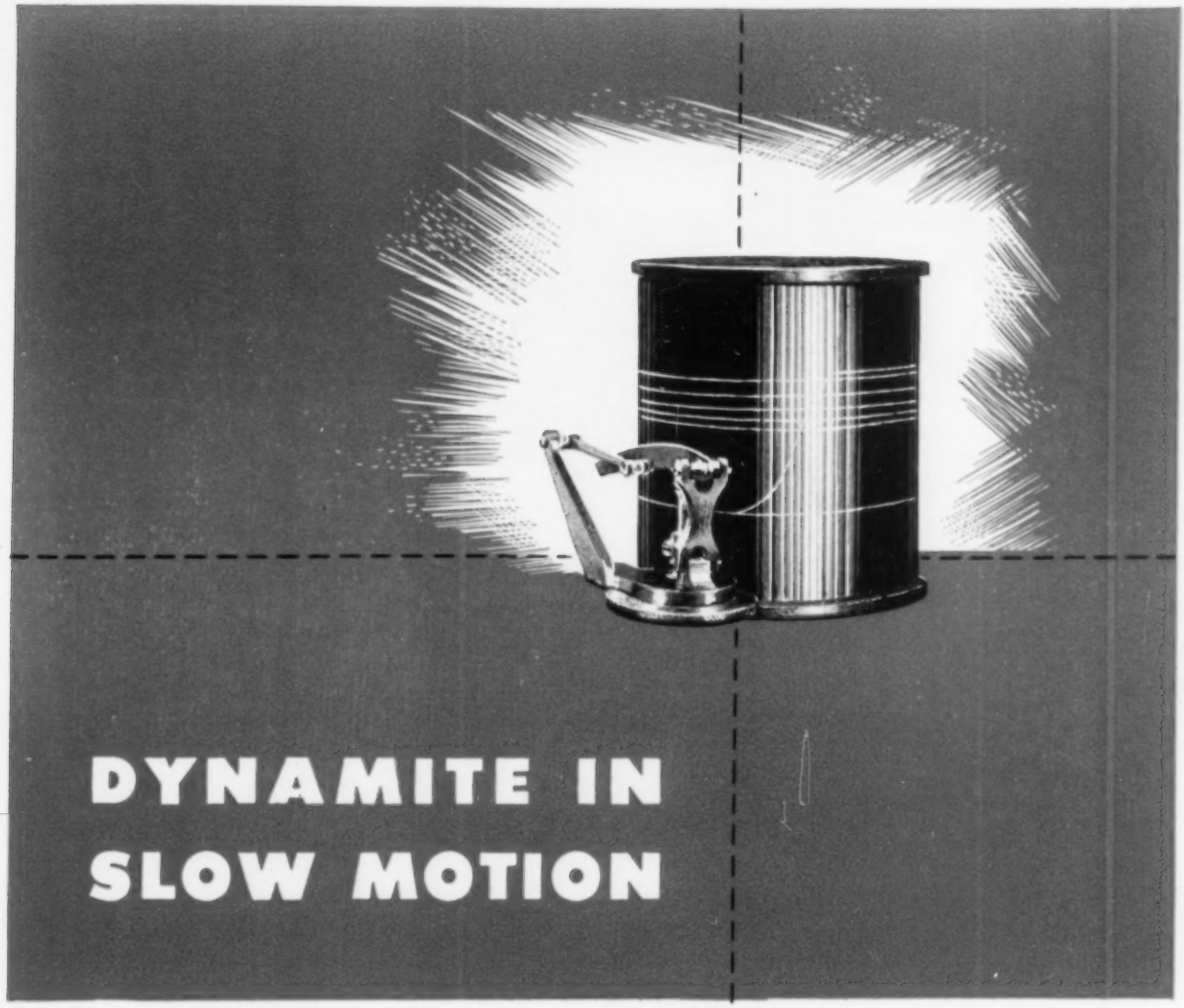
W. H. NICHOLSON & CO.
180 OREGON ST., WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

Babbitrite STICKS to the JOB!

Here is a babbitt retainer which has a 20-year record of *sticking to the job* under all working conditions. It is not affected by heat, is moisture-proof, will not melt, harden or dry out and speeds up babbitting operations. It provides absolute protection to workmen because it does not "blow out". Comes ready for use. May be re-used 100 times or more.

Write for a liberal sample.

Babbitrite THE BABBITT RETAINER
PRODUCTS MFG. CO.
517 E. Buffalo Street
MILWAUKEE 2, WISCONSIN



DYNAMITE IN SLOW MOTION

TRANSLATING THE DETONATION of an explosive into a continuous line . . . and thus charting the exact rate at which pressure is developed is one of the tasks of the recording device pictured above. In effect, it produces a slow-motion picture of an explosion so that its characteristics may be accurately observed.

Through apparatus such as this in one of the most modern laboratories, Hercules technicians study the behavior of explosives of almost every type . . . and thus add to their background of knowledge. It is this wealth of experience—in research, in the field, and in manufacturing—that maintains a constant vigilance over the quality of Hercules explosives, for your benefit and ours.

HERCULES EXPLOSIVES

HERCULES POWDER COMPANY
INCORPORATED
932 King Street
Wilmington 99 . . . Delaware

XB-41

JEEPS AND SUCH

THE NEW AND THE OLD. It is a world of change—of rapid change. Especially is this true in the field of military science and production. We have new vehicles such as the jeeps and super-jeeps here pictured: also other novel vehicles capable of running on the ground or in the sea; new landing barges; new tanks and tank destroyers—new things, in short, almost without end.

So rapid are these changes that much which is new today is obsolete tomorrow. But not everything. . . . Take pencils, for instance. These vital instruments, essential to much of this new invention and development, are old reliable standbys. For many years engineers, architects, designers, draftsmen, artists and others, have found **Koh-i-noor Pencils** capable of meeting their most exacting demands. Even in these times of stress, there is no lowering of manufacturing standards; your **Koh-i-noor** will still give you that perfect line or tone. Among the seventeen reliable and carefully graded degrees you will find a **Koh-i-noor** ideally suited to your hand, to your paper, and for your particular purpose.

Is your work freehand? You will like our softer grades, ranging from HB to 6B. Is it instrumental? Are you doing drafting? Then try **Koh-i-noors** from H to 9H.

Reproductions of this drawing and several others of this series are now available, and will be supplied without cost. When writing, please mention COMPRESSED AIR MAGAZINE

SAVE
DON'T WASTE
PENCILS

NO. 930 AVIATOR COLORED PENCILS are manufactured in 24 brilliant, smooth-working colors. Artists find them efficient where a limited range of colors is needed for general sketching, photo coloring, map work, etc. Purchase them at your dealers in single colors or in sets. No. 936—12 assorted colors, or No. 938—24 assorted colors.

SEND FOR FREE CATALOG NO. 19

SAVE
DON'T WASTE
PENCILS

KOH-I-NOOR PENCIL COMPANY, INC., BLOOMSBURY, NEW JERSEY

Win with KOH-I-NOOR!

BE SURE YOUR NEXT PORTABLE COMPRESSOR

has all of these features

1. Multi-speed regulator which automatically adjusts the engine speed to the use of air and practically eliminates wasteful idling... reduces average working speed of compressor and engine, resulting in more efficient operation and longer life ...and with pressure characteristics that will get more work out of air tools. (On MOBIL-AIR compressors, this regulator is called the "Drill-More" regulator.)

2. Convertible engine... quickly changed from operation on one fuel to another (gasoline, oil, or natural gas) by substitution of external fuel accessories only.

3. If a gasoline engine, the most economical type... which will make substantial savings even with regular gasoline and at all loads.
Or if an oil engine, a low-compression type that is easily started and easily maintained.

4. A modern two-stage air-cooled compressor with Channel Valves.

5. Unified assembly of compressor and engine ...maintaining permanent alignment.

6. Light weight...but strong, sturdy, and tough.

7. Reasonable over-all dimensions.

8. Sturdy, easily operated and easily maintained clutch.

9. Electric cranking (for oil as well as gasoline engine) with commercial 6- or 12-volt equipment.

10. All operating controls and gauges centrally located.

11. Stream-lined design... for strength and durability.

12. Low, easily filled fuel tank.

13. Spring mounting and automotive steering if 210 cfm size or larger, 2-wheel trailer for all smaller sizes.

14. A fine, durable finish.

15. Proven design and performance.

These features are built into MOBIL-AIR compressors... 5 sizes 105 to 500 cfm. These are the portables that decreased gasoline consumption as much as 40% compared to best previous models...and that established new records of endurance, reliability and low maintenance. Insist that your next portable is a MOBIL-AIR.

Ingersoll-Rand MOBIL-AIR AIR POWER

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

2-43

COMPRESSORS - AIR TOOLS - ROCK DRILLS - TURBO BLOWERS - CONDENSERS - CENTRIFUGAL PUMPS - OIL AND GAS ENGINES

FOR THE WAR PROGRAM

27 BULLETINS on Ball Bearings — their use, installation and maintenance.

Available to Engineers, Designers, Draftsmen, Shop Men, Service Men and Maintenance Men.

Sent on your request; write, giving your title or position and name of company.

TYPES OF BALL BEARING MOUNTINGS
MRC
M-R-C
Load Computation Manual
PREPARING SHAFTS for BALL BEARINGS
HOUSING BORE LIMITS FOR BALL BEARINGS
TYPICAL MOUNTINGS OF SNAP-RING BALL BEARINGS
OIL LUBRICATION OF BALL BEARINGS—HIGH SPEEDS
SHAFT SHOULDERS AND SHAFT FILLETS
SEALS AND SLINGERS FOR BALL
OIL LUBRICATION OF BALL BEARINGS
DUPLEX BEARING MOUNTINGS
GREASE LUBRICATION OF BALL BEARINGS

M-R-C LOAD COMPUTATION MANUAL is a 68-page booklet of methods for calculating loads on bearings. Sent free to mechanical engineers and draftsmen. Send request on your company stationery.

M-R-C BALL BEARINGS

MARLIN-ROCKWELL CORPORATION

Executive Offices: JAMESTOWN, N. Y.